EDITORIAL

WE should not attach too much importance to the TV licence figures recently issued by the PMG's Department.

They don't really prove anything to indicate how the stations are progressing or how enthusiastic the people are about the matter.

And it would be very unwise to jump to any premature conclusions based upon them.

By the time this issue appears, it is probable that Victoria will have about 8000 licences and New South Wales 4000.

And that's not too bad an effort.

It is quite astonishing how the publication of licence figures has drawn forth conflicting comments.

One of my friends, closely connected with entertainment work, was appalled that so few people had taken out licences. He could not see how any venture which had attracted so few adherents could possibly succeed.

Others have seen quite a landslide to TV in the fact that 10,000 sets were licensed after a month of official operation.

Personally I don't subscribe to either viewpoint.

But I think it is most significant that Melbourne has about twice as many sets as Sydney. The Olympic Games is obviously the reason for this. I'm quite sure that if Sydney had possessed an equal drawcard, the set sales in each city would have been about the same.

What would surprise me would be to find that Melbourne continues to outsell Sydney by about two to one. As it is, we have had a demonstration of something we all know by this time, that the biggest incentive to TV popularity is a good program.

It's too early yet for us to criticise station performance seriously. We must give everybody a chance. In both Sydney and Melbourne I've seen plenty of poor camera work, poor and amateurish presentation, dull interviews, low-grade films and the like.

But from now on, we are entitled to expect things to improve. The first fascination of TV is quite naturally easing off, and crowds don't mill around window displays as enthusiastically as they did. I think the next six months will in many ways set the pace for the immediate future.

But I can't subscribe to any ideas that TV won't grow. I think my friend will be surprised before very long to find what a bad guesser he has been.

John Moyle

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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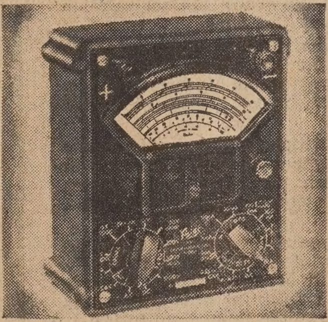

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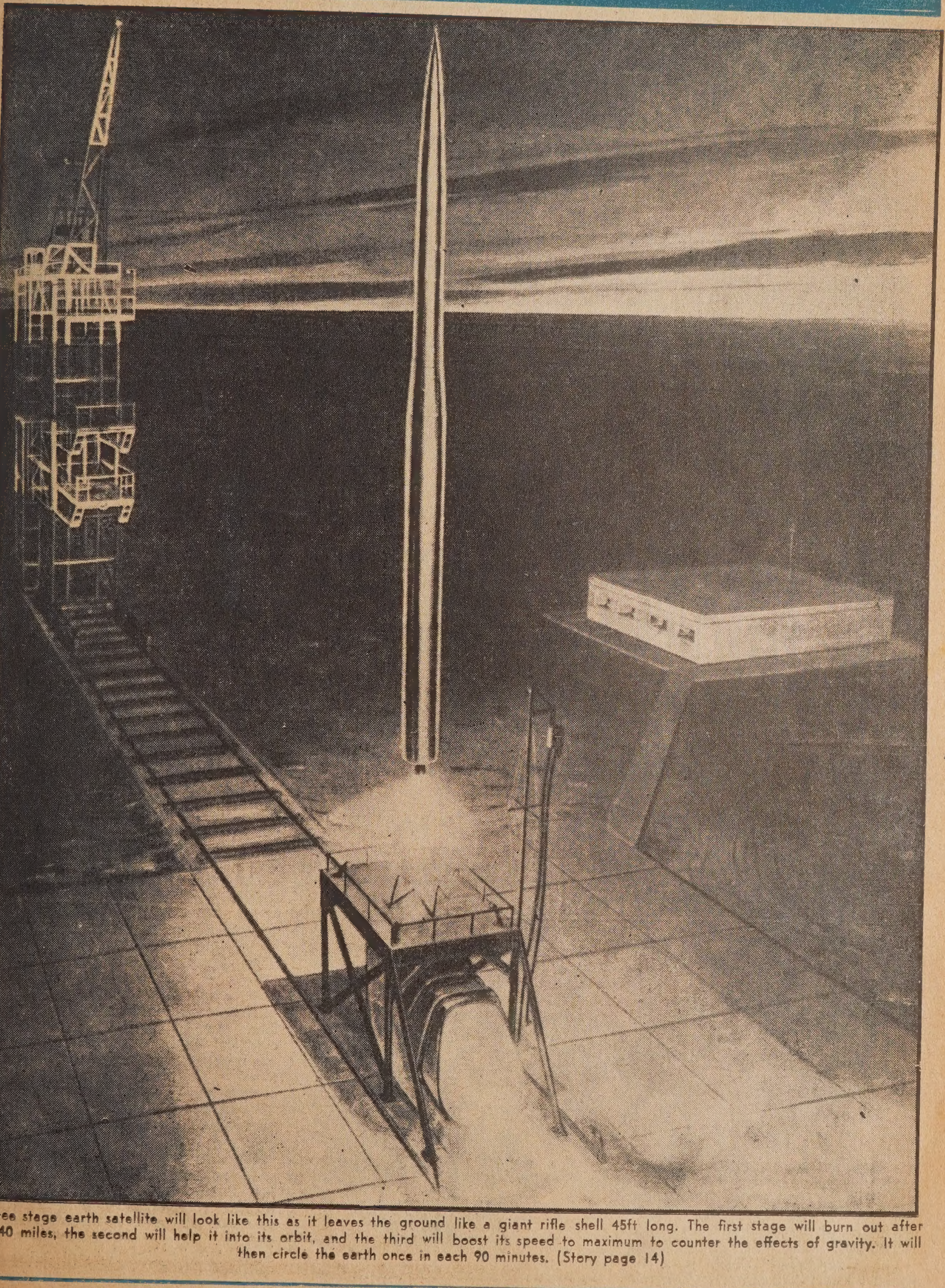
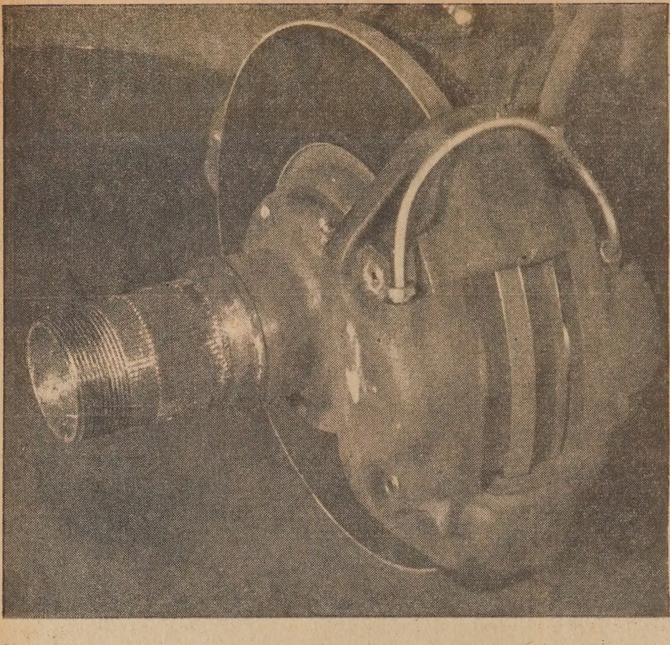
AN EARTH SATELLITE SETS OUT



Three stage earth satellite will look like this as it leaves the ground like a giant rifle shell 45ft long. The first stage will burn out after 30-40 miles, the second will help it into its orbit, and the third will boost its speed to maximum to counter the effects of gravity. It will then circle the earth once in each 90 minutes. (Story page 14)

BIG CHANGES AHEAD FOR CARS

Higher efficiency and simplified driving are likely to feature prominently in the design of motor cars during the next year or two. Fuel injection, sometimes electronically controlled, automatic transmission and disc brakes are already featured on better class models. Soon they will find their way into smaller and more standard cars.



At least four British manufacturers have announced 1957 models using disc brakes as standard equipment. Photograph shows the Girling design.

By Pedr Davis

CARS for 1957 are different. Tougher world markets and the changing tastes of motorists have forced both European and American manufacturers to introduce many new ideas and improved mechanical features.

The styling too is different. The cars are mostly longer, lower and leaner, with greater areas of glass in all four directions. But the biggest changes have been mechanical.

HIGHER POWER

Of the world's manufacturers, 90 pc have introduced more powerful engines. Some European firms have done this merely by enlarging the bore capacity, while American firms who are rapidly reaching a maximum in engine size and weight, have turned to mechanical boosters. The surprise turn has been the introduction of a supercharger on the Studebaker as standard equipment on the Golden Hawk range. It is now the only American production car fitted with a supercharger as original equipment.

The supercharger which is a five pound boost, full pressure system, rams some 30 pc more fuel and air into the combustion chambers. This results in a 15 pc increase in power output with a comparatively small gain in weight. The unit is driven through a variable rate pulley which produces maximum power during acceleration and allows normal fuel economy at cruising speeds.

Chevrolet have turned to fuel injection for their power. Fuel injection has been the subject of much discussion during 1956 but its general principles are worth repeating.

"Solid" injection takes place when a pump squirts raw petrol into each cylinder at the critical moment. The air then comes in through the inlet manifold in the normal way. The German Goliath and the Mercedes Benz are the best known exponents of this system.

The other type of fuel injection squirts a mixture of both petrol and air into each cylinder through a special nozzle.

Although the technical details vary, fuel injection has the big advantage that it pipes fuel direct to each cylinder, thereby ensuring even and accurate distribution. Furthermore, the reaction of the engine to throttle control is much quicker than with a conventional carburettor, giving it a very "solid" feel.

FUEL INJECTION EFFICIENT

Tests have shown that fuel injection systems increase power by 20 pc, improve fuel consumption by about 10 pc (greater efficiency), and promote more even running of the engine.

Chevrolet are the first American manufacturers to announce fuel injection on their production models, although most manufacturers are known to have been experimenting with the system for 12 months or more.

Equally interesting is the electronic fuel injector recently announced by Bendix in America. It departs radically from all other designs. Called the "Electrojector", the system is unique in that is is electronically rather than mechanically controlled.

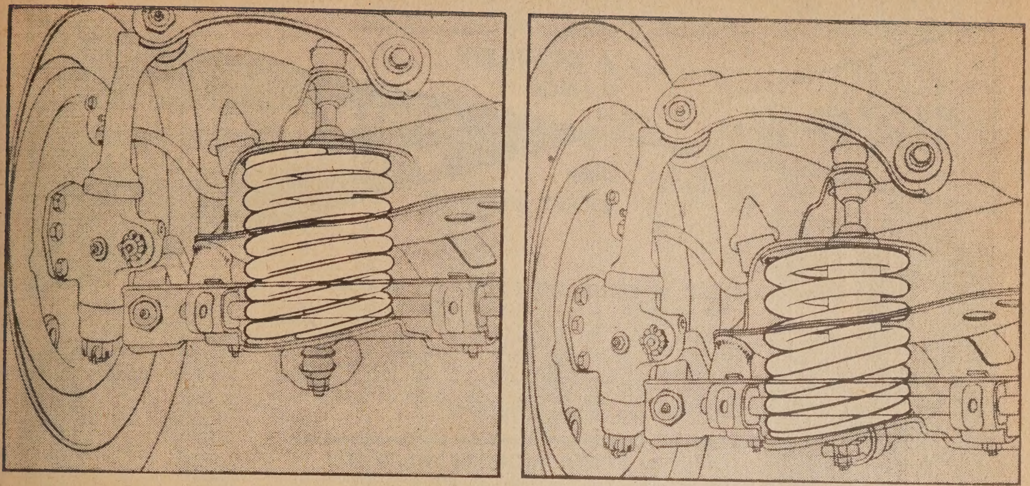
Using transistors, it senses fuel requirements and electronically actuates injector nozzles which spray fuel directly into the intake port of each cylinder, whereas conventional systems use a mechanical drive direct from the engine.

The heart of the unit is an electronic control box, measuring four by five inches. In simplified terms, it gathers information as to the engine's requirements at a given fraction of a millisecond and then electrically controls the amount of fuel charge to be injected into each cylinder.

The metering system is simple. As a larger volume of fuel is needed, the electrical impulse to the injector keeps the injector valve open for a longer interval. Timing of the injection is accomplished by a wafer unit in the distributor, bearing a set of breaker points identical to the ignition points.

ELECTRONIC CONTROL

In operation, the electronic control box gathers the following data: Full throttle enrichment from an electronic sensor in the manifold, acceleration enrichening from a sensor on the throttle shaft; "choke" (needed for starts and warming up), from a thermostat mount-



One of the most interesting of the new suspension systems to reach the market for 1957 is the Studebaker variable rate coil spring. Its action is shown diagrammatically in this illustration.

ed in the water jacket. The control box is able to correlate instantaneously this information and meter out the injection charge.

At the present time this unit is in the development stage, although it is being widely tested on Lincoln, Chrysler and Buick cars.

In Britain, Lucas, the electrical accessory and auxillary manufacturers, have also developed a fuel injection unit suitable for small cars. Already their device has been fitted to racing cars and has many victories to its credit, including Sebring, Nurburging and Le Mans. The unit has an electrically driven fuel pump supplying fuel under 100lb pressure to a metering unit driven from the camshaft drive. This supplies the exact amount of fuel required by each of the six injectors located in the six separate air intakes.

Among the interesting crop of 1957 innovations are new forms of disc brakes which appear to have overcome the teething troubles which beset the early experimental models. Both the Triumph TR3, "D" Jaguar, Citroen and Jensen have disc brakes fitted as standard equipment for 1957.

One of the most advanced production disc brakes is the Dunlop unit. This firm have not only spent thousands of pounds on research but they have also just completed a most modern plant (using automated transfer machines) to enable production costs of the disc brakes to be competitive with conventional drum and shoe units.

DISC BRAKES

Part of the wheel hub extends to a revolving disc which spins with the wheel. Small friction pads of high density material are placed on either side of it, so that they can under hydraulic pressure grip the disc in the manner of a pair of calliper brakes on a push-cycle. The hydraulic fluid is thermally isolated from the friction pads as the early forms of disc brakes were subject to fade due to the heat boiling the hydraulic fluid.

Brakes of this type require no servicing attention or periodic adjustment, as the pads are pushed forward by a component called a pad carrier to which they are attached by a small set screw. The pad carrier is in turn pulled back when hydraulic pressure is released by a retractor unit. This unit automatically adjusts itself for wear so that the pad is constantly close to the revolving disc.

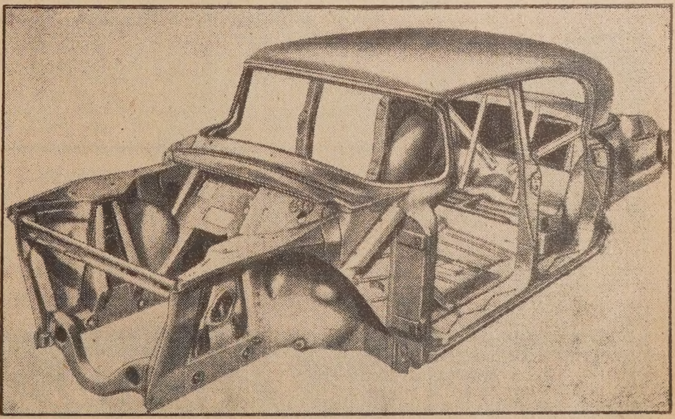
BETTER SUSPENSION

Higher engine powers and more powerful brakes have also led to a demand for improved suspension systems. Many new suspension systems appeared during 1956, including the revolutionary Citroen hydro-pneumatic arrangement. For 1957, some manufacturers have come up with some equally novel ideas. One of the most interesting of all comes from the Studebaker-Packard Corporation.

Their independent front suspension is fitted with a variable rate coil spring which is entirely new to the automotive industry. This new type of spring automatically adjusts itself to varying loads throughout the spring range. It also provides new driver control on rough roads by virtually eliminating pitching.

The variable rate spring compresses at an unequal rate, coil by coil. This compares with conventional springs which compress at an equal rate, leaving the same spacing between each coil under all load conditions.

With the Studebaker-Packard development, individual coils are eliminated from the springing action as they progressively nest against adjoining coils. This actually lessens the spring surface and causes the spring to become stiffer as the load increases. The manufacturers claim that the new suspension gives the same soft yet firm ride with an average load of two persons that is usually found only under a heavy load of five or six passengers. Another ad-



Nash are the first American manufacturers to turn towards unit construction body work thereby eliminating the chassis. Others are expected to follow suit for 1958.

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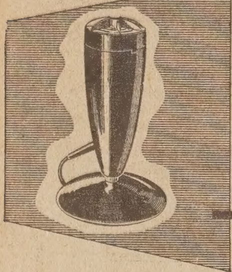


DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost **PRICE, £6/18/6.**

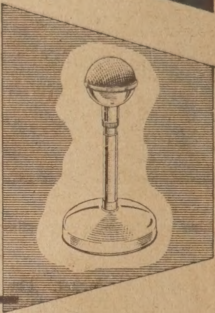
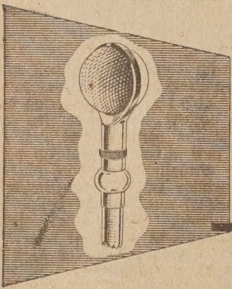


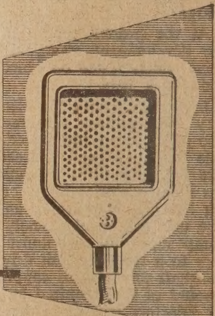
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost **PRICE, £9/18/6.**



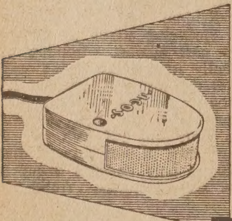
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise **PRICE, £24/19/6.**



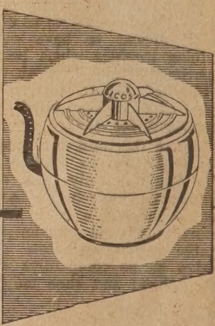
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6**



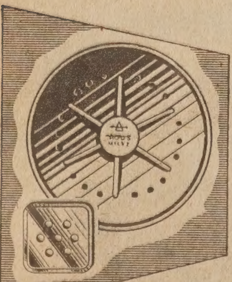
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



(MIC32 illustrated)
(MIC23 illustrated)

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These inserts are available in varying sizes, ranging from as small as 13/16 in. square to 1-13/16 in. round, with various thicknesses from 7/32 in. to 9/16 in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

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vantage is that the car remains level over severe bumps and that pitching is virtually eliminated.

New ideas on suspension are also being investigated by General Motors, Packard and Ford. The various ideas can all be divided into three distinct categories.

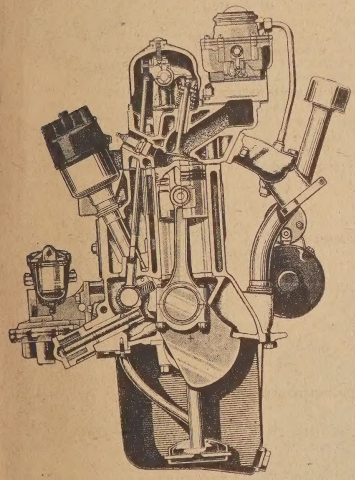
1. Self trimming springs which automatically adjust themselves for height when the load of the vehicle changes.

2. Inter-linked suspension units on the front and rear of the vehicle, to compensate for pitching movements.

3. Pneumatic springs (an old idea) in which compressed air is used as a buffer medium in place of laminated or coil springs.

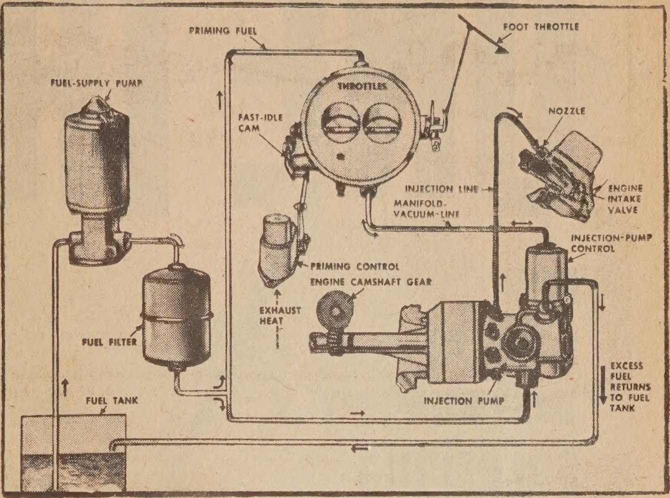
Considerable progress has also been made in recent months on the introduction of automatic drive. Many British and European firms have introduced fully automatic transmission on medium sized cars. This is no longer news but what is news is that clutchless gear changing is now being offered as optional equipment on such small cars as the Standard "10" and the Renault 750.

In all, there are three different automatic clutches on the market and small cars in Britain available with two-pedal control, include Standard, Austin, MG. Morris, Renault and Citroen.



Fuel injection and supercharging are supplying more power to engines of otherwise conventional types.

HOW FUEL INJECTION OPERATES



Fuel injection systems have seven main parts. Although they are more expensive and complicated than conventional carburetters, inherent advantages make them logical successors to modern methods.

The Ferlec clutch, fitted to the French Renault cars and available in Australia, is basically a conventional clutch using an electro-magnetic device to take the place of ordinary coil springs. The current to the magnet is supplied by the car's generator and the supply therefore varies with the vehicle's speed. At low engine speeds the current is insufficient to hold the clutch plates together and the engine will idle while the car is stationary and a gear ratio engaged. When the driver presses down the throttle, the increased engine speeds causes a rise in generator current and the clutch plates are drawn together. The car then moves off from rest perfectly smoothly.

There is also a special switch built into the base of the gear-change lever. When the driver rests his hand on the lever to change gear, the current to the clutch is cut off and a normal change can be made without the use of the clutch pedal.

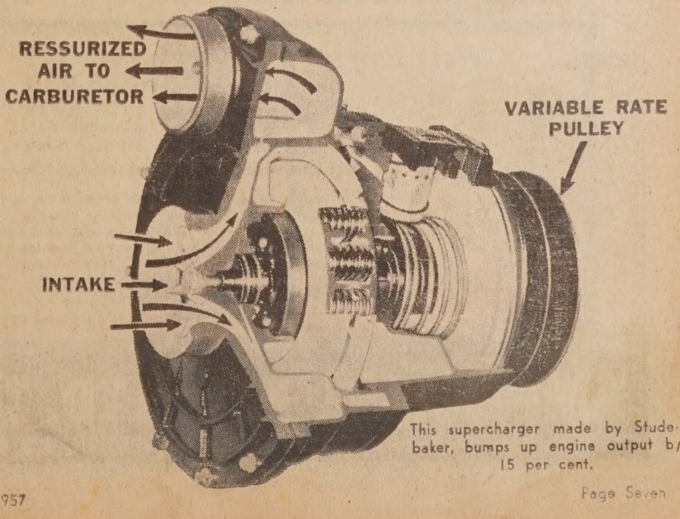
An interesting variation on theme (not yet in volume production) is the magnetic powder clutch, now being built in England by S. Smith and Sons, under an American licence. The unit is radically different from any other automatic clutch on the market.

There is a channel full of magnetic powder placed between the flywheel and the clutch. A solenoid coil runs through the powder so that when an electrical charge is sent through, the powder sets hard, forming a solid drive. The extent to which the powder can be magnetised depends entirely on the strength of the current, and, therefore, a smooth if rapid clutch action can be obtained by regulating the current. Once again, this is done by coupling the clutch directly to the car's generator. The gear-lever incorporates a pressure-sensitive switch so that the clutch becomes disengaged as soon as a driver goes to change gear.

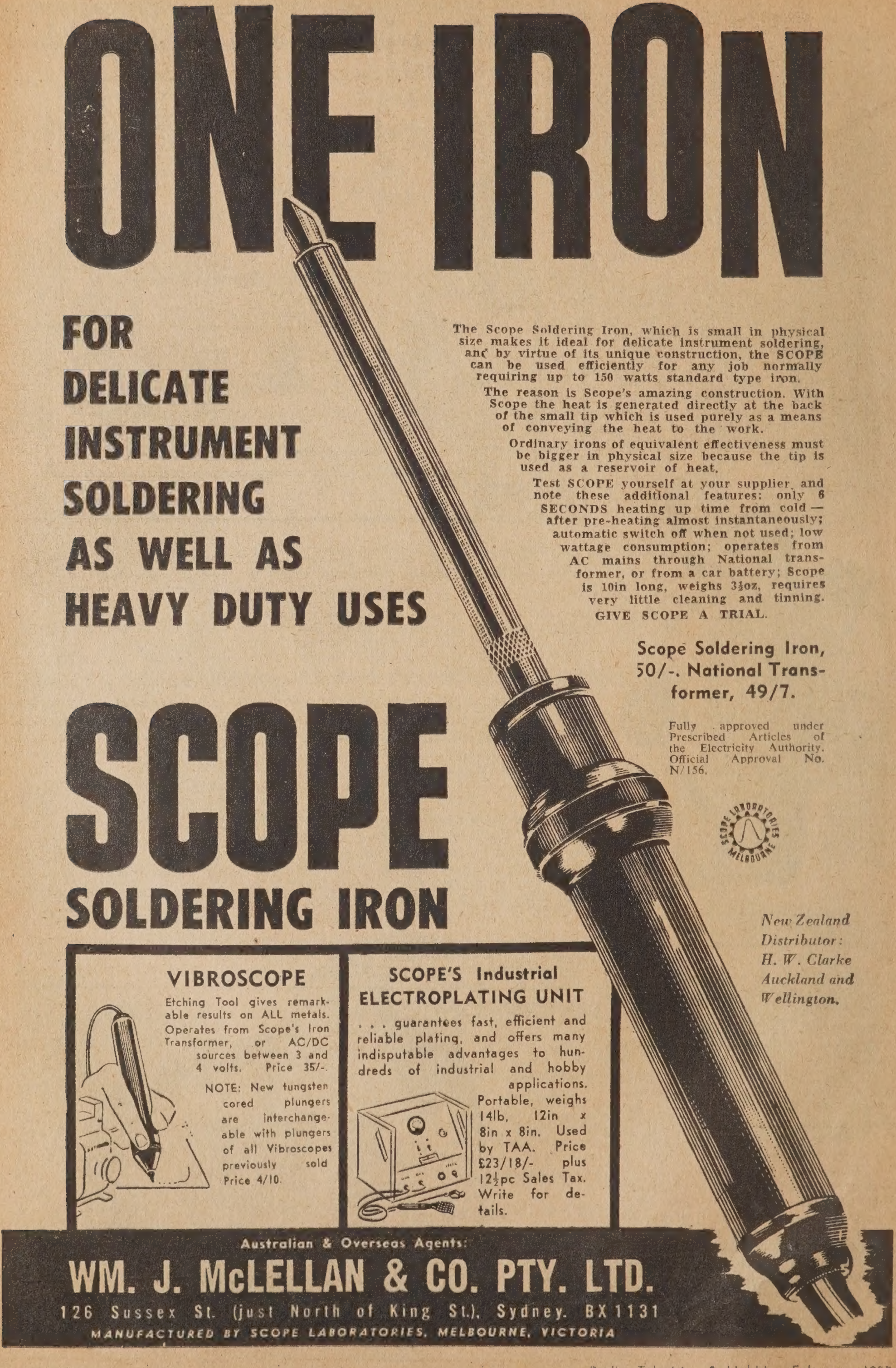
The most common form of automatic clutch in production is the combined servo and centrifugal unit, now being made by at least three different manufacturers.

The principle of a centrifugal clutch is well known. It contains a series of bob weights which fly out under centrifugal force, so causing the clutch plates

(Continued on Page 33)



This supercharger made by Studebaker, bumps up engine output by 15 per cent.



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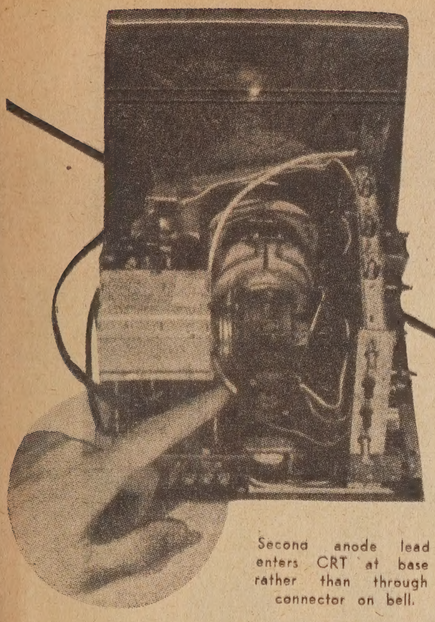
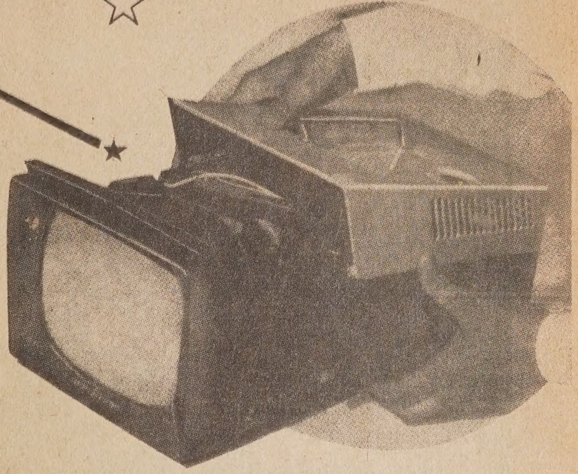
Design Features of 9" TV Portable



Second anode lead enters CRT at base rather than through connector on bell.



Removal of wrap-on aluminium cabinet exposes interior parts for service.

The introduction of miniature TV sets overseas, particularly in America, is a feature of the TV scene in that country, and represents an important advance in techniques and ingenuity. This highly interesting receiver made by GE uses 300mA heater valves and a liberal complement of semi-conductors to achieve compact size and light weight.

WEIGHING less than 13lb and no bigger than a breadbox, General Electric's new 9in portable TV receiver introduces many innovations in design, manufacture, and serviceability.

A new, lightweight, rectangular picture tube, printed and dip-soldered circuits, aluminum cabinet, miniature components, and wider use of semiconductors contribute to its lightness and compactness.

The prohibitive heat problem which would result with the use of conventional 600mA heater tubes has been eliminated by the use of the new 300mA types.

This step alone reduces heater power consumption and the accompanying heat dissipation problem from approximately 70 watts to 35 watts, and reduces total power consumption of the receiver to 70 watts.

Because the average consumer feels that service charges should be in direct proportion to the initial cost of the equipment, serviceability becomes an important consideration in the design of a low-cost, compact receiver.

EASY ACCESS

To this end, the physical layout of the receiver has been arranged to allow easy access to all tubes and major components as well as the new, twist-lock type of AC fuse shown in the chassis side-view photograph.

Fig. 1 shows the block diagram of the receiver which employs 12 tubes plus one tube rectifier, one selenium power rectifier, and five semiconductors.

Built-in UHF adds a 6AF4 oscillator tube and a mixer diode. The tuner is a conventional 12-position pentode type and this is the only major component that has not been miniaturised for this application. With UHF-equipped receivers, a 13-position VHF tuner is used, together with the added UHF tuner, to provide single-conversion reception.

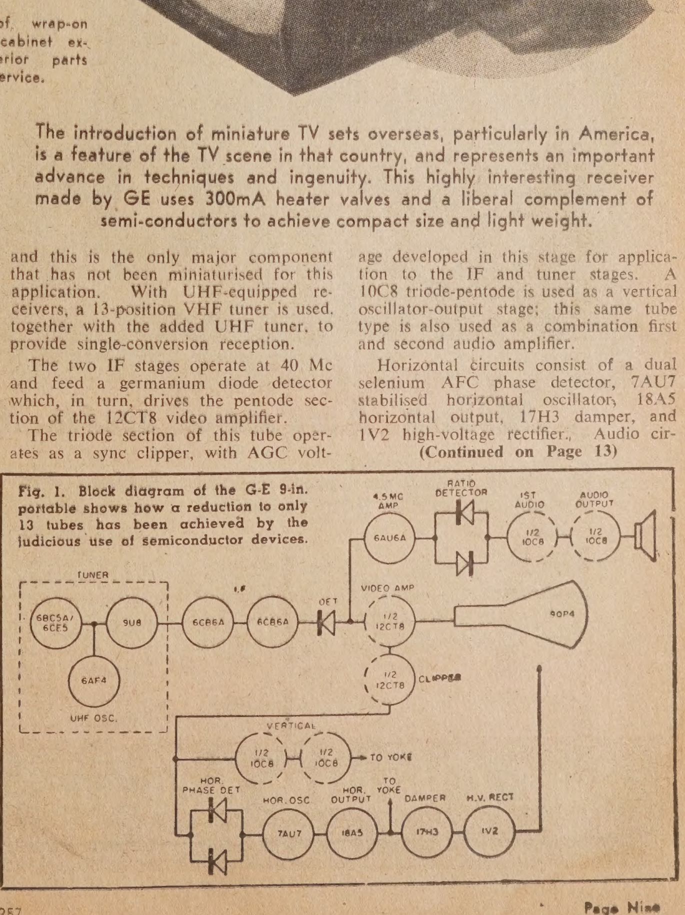
The two IF stages operate at 40 Mc and feed a germanium diode detector which, in turn, drives the pentode section of the 12CT8 video amplifier.

The triode section of this tube operates as a sync clipper, with AGC voltage developed in this stage for application to the IF and tuner stages. A 10C8 triode-pentode is used as a vertical oscillator-output stage; this same tube type is also used as a combination first and second audio amplifier.

Horizontal circuits consist of a dual selenium AFC phase detector, 7AU7 stabilised horizontal oscillator, 18A5 horizontal output, 17H3 damper, and 1V2 high-voltage rectifier. Audio cir-

(Continued on Page 13)

Fig. 1. Block diagram of the G-E 9-in. portable shows how a reduction to only 13 tubes has been achieved by the judicious use of semiconductor devices.



A P.M.G. team securing an underwater cable on the shore of Apollo Bay, Vic.

Miles Turned into Minutes

Almost 40 million words were received by cable in Australia from overseas last year.

Birthday greetings . . . wedding congratulations . . . news that you were glad to hear, or news which made you sad. They all were vital links in the pattern of living.

All over the world, telegraph and cablegram messages have removed international barriers and have reduced miles to minutes.

Leakage Prevented. It is a never-ending task to keep millions of miles of cable lines working efficiently.

Shell scientists have discovered that a casting resin* derived from petroleum can be used for cable splicing.

Treatment with this SHELL product seals cables completely and the seal does not deteriorate.

**Epikote Resin*

WHAT MAKES WHISKERS GROW?

Atomic radiation spurs the growth of hairlike metallic strands—called "whiskers"—on metal, it has been found by Bell Telephone Laboratories scientists. More than five years ago the Bell System's research and development unit found that microscopic metal "whiskers" had literally grown on some types of telephone equipment and had caused short circuits. The discovery of the metal "whiskers" opened a new avenue of scientific research and thousands of tests were made in the laboratory.

RECENTLY, Bell Laboratories has grown small, needle-shaped synthetic crystals of germanium and silicon. materials widely used in transistors and other tiny electronic devices. These and other whisker-like crystals have been demonstrated to possess great strength.

Some time ago engineers wondered if the samples of metals they had been testing for whiskers would behave in the same way if they were exposed to bombardment by neutrons in a nuclear reactor. Samples of tin were placed in the reactor at the Brookhaven National Laboratory and removed a month later

MORE WHISKERS

Examined recentry after a year of "cooling off", the irradiated samples were found to have grown more whiskers than identical ones on shelves, in ovens and in cold chambers at Murray Hill. Metallurgists explain that damage to the crystal structure of the metal caused by the neutron bombardment had increased the tendency to produce the minute filaments.

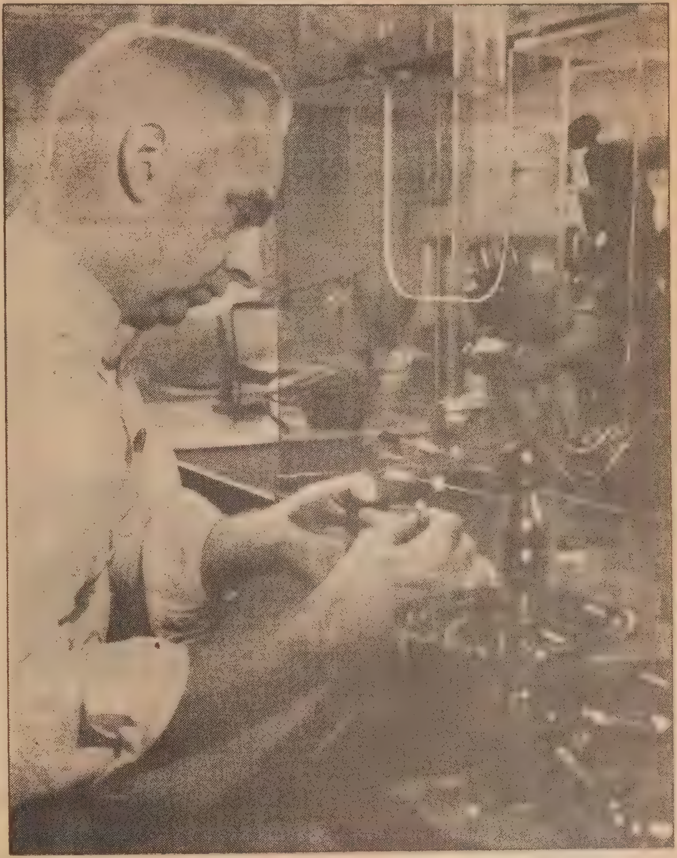
The fact that metal whisker growth is greatly accelerated by radiation will be studied further by many scientists concerned with metals. The test of the effect of atomic radiation, latest of an extensive series conducted by S. M. Arnold, Bell metallurgist, is but one part of Bell Laboratories' general program of metal whisker research.

With the increased use of tiny electronic parts likely in the telephone industry and elsewhere, whiskers could cause short circuits between minutely-spaced metal surfaces. Telephone scientists know that design of new electronic equipment must take into consideration the whisker-growing potentialities of various metals.

USE OF MICROSCOPE

X-ray studies have been made of the atomic or crystal structure of whiskers. These reveal the "crystal direction" in which whisker growth takes place on certain metals. Knowledge of this will help scientists to understand how to grow or retard the growth of whiskers.

The whiskers on some metals do not grow large enough to be seen through an ordinary microscope, and an electron microscope provides the only way of determining their growth. On other metals which grow large whiskers, the electron microscope detects sprouting before the whiskers are large enough to be seen through an ordinary microscope.



A Bell Telephone Laboratories metallurgist, S. M. Arnold, adjusts probes he fitted into transparent plastic shield surrounding microscope. The probes enable Arnold to set whisker-growing metal samples into places easily accessible under microscope. Device in the right foreground, a micromanipulator, is used for making finer adjustments of the specimens. Plastic shield protects the delicate filaments from air motion and dust.

While whisker growth is a new field of research, there have already been tangible results in the form of recommendation concerning the use of some metals.

Bell Laboratories scientists found whisker growth on platings of zinc, tin and cadmium used as finishes in telephone apparatus. In critical circuit applications where whiskers could cause short circuits these platings have been discontinued and non-whisker sprouting metals have been substituted.

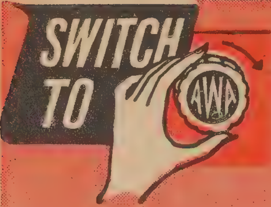
Gold plating was recommended for use instead of tin in the repeaters of the transatlantic telephone cable, which just went into commercial operation. In extensive tests, gold had been found to be whisker-free under operating conditions.

Whisker-proof plating metals are used in the metal "can" assembly of the transistor.

HOW IT STARTED

Whisker research really began with a specific case of trouble-shooting on a long-distance telephone circuit. The culprit was found to be in a device called a "wave filter", important in making possible dozens of conversations simultaneously over a single telephone circuit.

One of the filter's components, a capacitor, had developed an unexplained "ground". An alert engineer scrutinised



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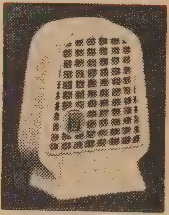
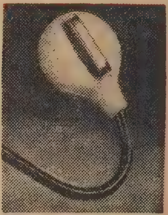
FF2-OV, FF2-P. "Fonofluid" crystal pickup with turnover alternate response characteristics.

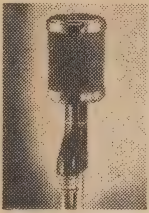


44. Hand or desk mounting, counter balanced base, ivory plastic housing

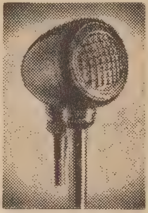


K407. Contact microphone for attachment to musical instruments — also used as throat microphone

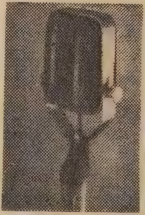
HM7. Hand or stand microphone, filtercell, robust diecast housing attractively finished.



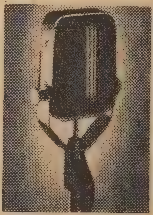
S742. Duo cell, omnidirectional, suitable for cable suspension.



B110. Plastic torpedo form.



R474. Studio type, 4 cell, omnidirectional.



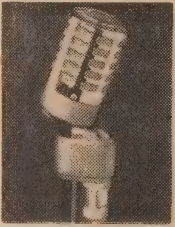
R572 and R572/L. Studio type, duo cell, omnidirectional, high or low impedance

RFC and RFC5/L. Single cell semi-directional, high or low impedance.

C53. Hand or stand, omnidirectional, black plastic housing and hand grip.

AWA Reslo

An extensive range of A.W.A. Ronette and Reslo microphones is available for all requirements.



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ALSO FROM LEADING WHOLESALERS

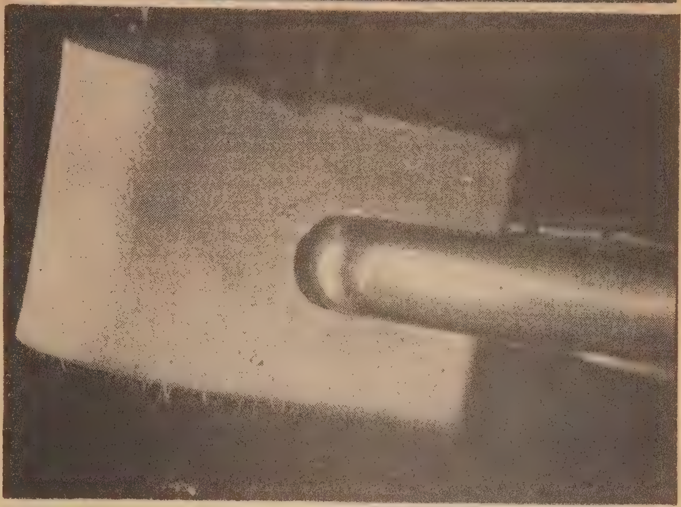
cuits make use of a 6AU6A 4.5 Mc amplifier and a pair of germanium the capacitor in a strong light with a magnifier. Something glinted. What looked like lint, but much finer, connected a "hot" terminal of the capacitor to a nearby mounting bracket 3-16th of an inch away, which was "grounded"

The tiny strand had conducted to "ground" the electricity that was intended to carry voices. Investigation showed that the zinc-coated bracket had grown electrically conductive whiskers.

The questions of what makes whiskers grow, and what they consist of, have since occupied many researchers at Bell Laboratories and elsewhere. More than 3000 samples of metals are now being treated at Murray Hill to determine whether they will produce whisker growths under various conditions.

When more is known about the growth, structure and physical properties of whiskers, it may be possible some day to apply this knowledge in making metals far superior in strength and durability to today's metals. One of the most interesting facts about the whiskers is that their strength far surpasses the strength of the material from which they sprouted.

STRANGE RESULT OF RADIATION



A piece of ordinary tin-plated metal with whiskers is shown above as it appears through a microscope. It had been kept in a glass jar at room temperature for about three years at Bell Laboratories The whiskers, which are single crystals of tin, range up to 3/16th of an inch in length and 80 millionths of an inch in diameter. The curved metal sample—ordinary cold rolled steel electroplated with tin — is one and a half inches long, one-half inch wide and 1/32nd of an inch thick. It is held by a spring clamp with teeth about 1/8th of an inch wide.

Design features of 9in TV portable

(Continued from page 9)

diodes as the ratio detector which drives the 10C8 audio stages. "B plus" voltage originates from a single selenium rectifier supply which delivers 135 volts.

The 9QP4 picture tube, recently developed by the Tube Department of the General Electric Company, represents a considerable departure from conventional picture tube manufacturing in that the tube bulb is blown into shape in the same manner as a light bulb.

Elimination of the usual heavy face plate by use of this technique results in a 9in tube with the remarkably low weight of 2lb.

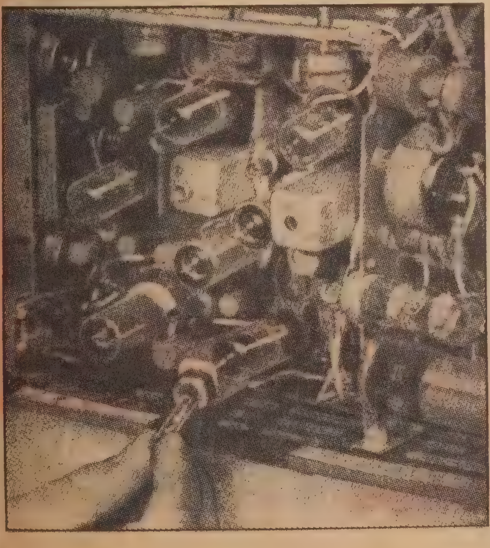
A 70-degree electromagnetic deflection system is employed, together with electrostatic focus. Since the glass used in the manufacture of this tube is not a perfect insulator, the high-voltage terminal appears on the base rather than on the bell of the tube. The value of this second anode supply is on the order of 8000 volts. Aluminisation of the screen is not used because no improvement in brightness would be gained with the comparatively low anode voltage.

A filter-type safety-glass is used, however, to improve the contrast ratio.

One photo illustrates the manner in which the wrap-on aluminium cabinet is removed to expose the interior of the receiver. Servicing of components on the one printed board is relatively simple because all components are on one side of the board while the reverse side is exposed and accessible.

Operating controls on top of the cabinet are channel selector and fine tuning; contrast; vertical hold; and volume—"on-off". Rear controls include brightness, horizontal hold, height and vertical linearity.

(By special arrangement with Radio and Television News, USA.)



A novel feature is a convenient accommodation for the AC fuse. It is located on one side of the chassis in a housing that resembles an IF can. This makes it readily accessible for examination as well as replacement. This picture also gives an idea of the compact layout.

☆

Classroom TV

THE BBC will start television programs for schools this year.

The programs should help the "non-bookish" child, says the chief of the BBC Education Department, Enid Love.

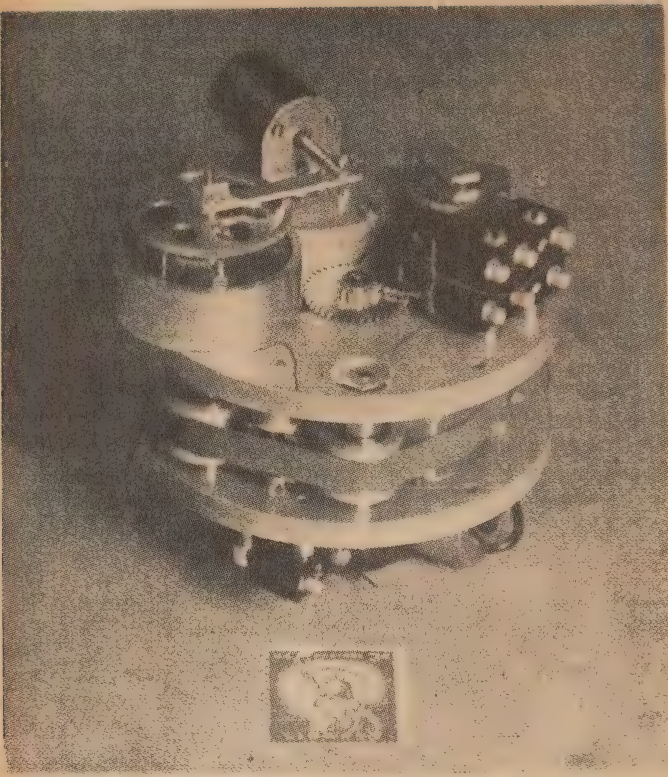
The programs will include:

- Current events.
- Science films with animated diagrams and talks by scientists.

By the time the programs begin—in September next year—the BBC will have experimented for two years with selected classes.

At first it was thought that the ordinary television screen was too small to be effective in a large classroom.

But experiments have shown that the largest commercial screen is adequate and daylight is no drawback.



A miniature tape recorder specially developed for use in a satellite. The tape will store data for 120 minutes and read it out, upon command, during the few seconds in which the satellite is within range of the station.

MAN'S FIRST STEPS INTO SPACE

Fiction has a way sooner or later of becoming fact, and no type of recent fiction has seemed so fantastic as that dealing with space travel. But there can now be no doubt that only time lies between the dream and the reality of sending man made vehicles out to the limits of the earth's control.

by Calvin Walters

It is hoped that the first satellite will be launched early in 1958 as part of the various scientific projects to be carried out during the Geophysical Year 1957-58.

To the average man in the street who is interested in this sort of thing various questions will come to mind.

NOT SO SPECTACULAR

What will the satellite look like? How large will it be? How will it be launched? How far into space will it travel? Will we be able to see it? What good will it do us?

To those interested in space travel the satellite program is one of fascination with imaginations running riot along the line of space ships and trips to the moon.

The artificial satellite will be nothing as spectacular as that although it will be spectacular enough in the launching.

The satellite itself will probably be merely a metal ball weighing about 20 pounds. It will, of course, be launched by means of a rocket.

The progress made in the past few years in the art of firing rockets into the upper atmosphere has been so great that nobody doubts that one can be made which will carry the artificial satellite on to its selected orbit around the earth.

It was over 300 years ago that Newton formulated the science of celestial mechanics. The laws emanating from this make it quite clear just what man must do in order to get his artificial satellite into space.

SHAPE OF ORBIT

The laws enable him to calculate to what height the satellite must be launched, at what speed it must travel and what it must weigh and how long it will stay up.

For the first time in history man will utilise the laws of celestial mechanics to suit his own convenience. He will be able to choose the orbit around the earth for his satellite. He will select the right size satellite to suit his pocket and utility.

The only thing he will be unable to choose is the true shape of the orbit. It will be elliptical whether he likes it or not with the earth's centre as one of the principal foci.

A truly circular orbit is the most desirable and no doubt attempts will be made to make the orbit as circular as possible.

It will not be possible to have a truly circular orbit. The best that can be expected is that it will be slightly elliptical.

A circular orbit would be the most useful for various reasons. Firstly it would be in the line of sight throughout various parts of the globe at all times. Secondly it would stay up for a longer period.

MUST CIRCLE EARTH

When the satellite is on an elliptical orbit it must travel through low altitudes during part of its journey. It will thus during that period travel through denser air. This atmospheric resistance will slow it up and it will take a spiral course into regions of denser atmosphere where it will finally be burnt up by heat generated by friction.

The orbit must be such that the centre of the earth will lie within its plane. We cannot, for instance, have a satellite revolving around the Arctic Circle.

With this restriction we can place the orbit where we like.

This gives a wide choice. The orbit can be around the equator or around both poles. It can be inclined to the equator at any angle between 0 and 90 degrees.

TECHNICAL LIMITS

It is only technical limitations which restrict us in the size of the orbit. Theoretically we should be able to shoot a satellite to any height, but our present state of rocket development will not permit shooting it to a height greater than about 300 miles above the earth.

In order to keep a satellite on its orbit at a height of 300 miles, it will have to be given a speed of five miles per second

Scientists have as yet been unable to deliver this speed to a rocket. Five miles a second is 18,000 miles per hour. The present record for a rocket is 6000 miles per hour at a height of 250 miles. This was established in 1949 with a two-stage rocket.

ROCKET SIZE

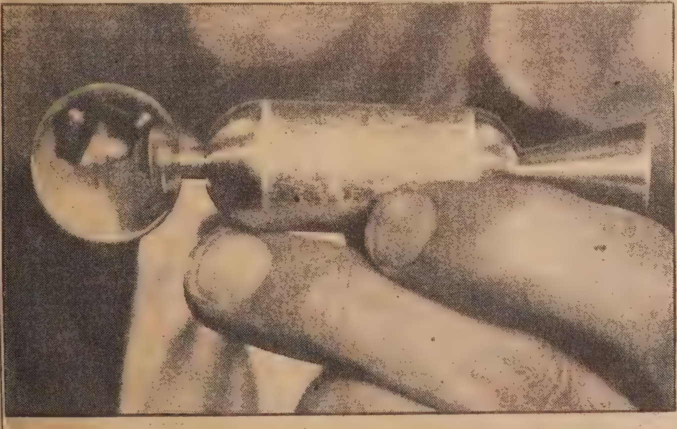
Scientists have calculated that in order to get a satellite on to its orbit at 300 miles at a speed of 18,000 miles per hour, it will require a rocket weighing some 22,000 pounds. Even then the weight of the satellite will not exceed 20 pounds.

It would seem that a slightly larger satellite would be preferable and one of, say, 40 pounds weight would not require a much larger rocket. It doesn't work out that way, for a 40 pound satellite would require a rocket of 44,000 pounds weight to launch it to the required height of 300 miles.

That is why the satellite must be small. Our progress in rocketry is not sufficient to do any better.

INSIDE AN EARTH SATELLITE

A workman at the U.S. Naval Research Laboratory places the electronic circuit "package" into an earth satellite being prepared for launching on its world orbit some time this year.



A model, 1/25th actual size, of the man-made satellite. Attached to the circular sphere which is the actual satellite is the third stage rocket which will supply the final push, then drop away. The satellite itself will weigh only 21½lbs.

The satellite could not be launched to 300 miles with a single stage rocket.

In order to overcome the weight of the rocket the satellite will be launched in three stages. We start with a very large rocket which has a medium-sized one on top of it. On top of this again is a small one containing the satellite.

The whole multiple rocket will first of all be fired vertically. It will gradually tilt to an angle of 45 degrees, and at burn out will have travelled to a height of 36 miles, and have attained a speed of 3600 miles per hour.

SECOND STAGE

The second stage rocket will now fire and reach a height of 140 miles at a speed of 11,000 miles per hour. The retarded force of gravity and air friction will enable this section of the rocket to "coast" to a height of 300 miles, where it will have been reduced to a speed of 9000 miles per hour.

At this stage it will have travelled 700 miles from its launching platform, and will have reached the critical

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Revolutionary "SCOTCH" Brand No. 33 Electrical Insulating Tape has a stretchy, rubber-like vinyl plastic backing that enables it to do the work of two ordinary tapes. Goes on in one operation, instead of two, and does a better job. Its stretchability and resistance to oil and moisture equip it perfectly for a wide range of uses in electrical construction and repair. Its thinness gives it an important advantage in eliminating "overstuffed" junction boxes. Has a dielectric strength of over 9500 volts—only .007 inch thick. This tape may be used with equipment connected to Sydney County Council mains and under S.A.A. Wiring Rules.

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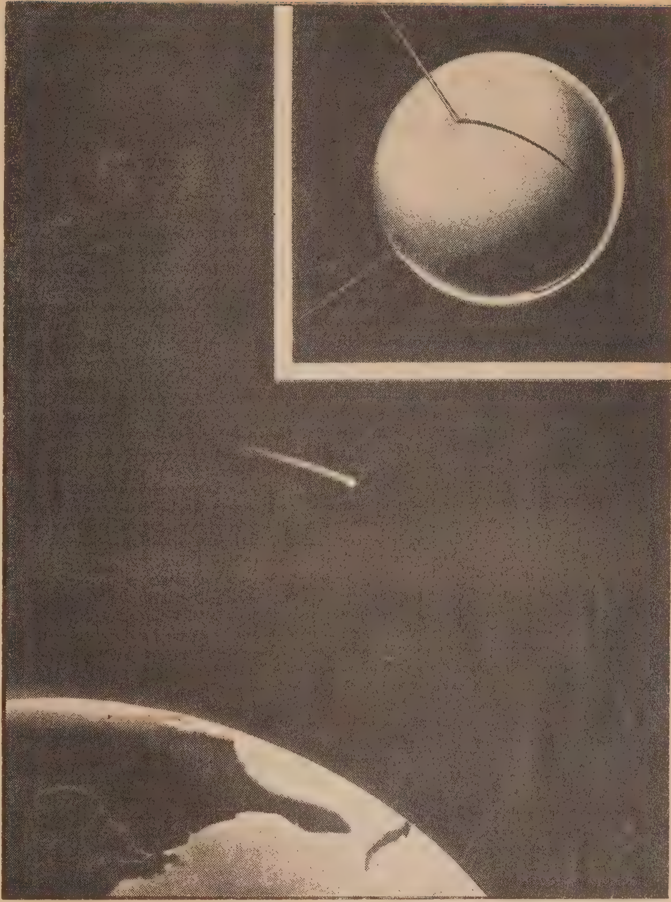
FROM SCIENCE FICTION TO FACT



An artist's idea of the man-made satellite—project "Vanguard," due to be released at Florida this year. Its outer skin will be 1/30 of an inch thick and it will travel at 18,000 miles per hour. It is expected to revolve 300-500 miles above the earth with a life of a few hours or a few months.

height for getting the satellite contained in the third stage, on to its orbit.

At the time of separation from the first stage rocket the second stage begins spinning on its long axis by means of "pin wheel" jets arranged around it. This tilts it more from the vertical to the horizontal, which is essential for the launching of the satellite.

The third stage is now fired and accelerates to a speed of 18,000 miles per hour at burn out. It is now 1500 miles away from the starting platform, and has travelled for the short time of ten minutes.

SATELLITE FORCES

At this moment, the satellite separates from the third stage shell and both continue together on the orbit.

The size of the orbit, its shape and its direction, are controlled entirely by the speed and direction at which the satellite is propelled at the moment of the last rocket's burn out. From then on the major force affecting the orbit of the satellite is the earth's gravitational field. It is this force which constrains the satellite on its elliptical orbit.

Other smaller forces acting on the satellite and which will cause pertubbations of its orbit are the impact of meteoric dust on the shell of the satellite, pressure of light itself, and gravitational effects of the sun and moon.

The main influences, however, are the non-spherical shape of the earth and atmospherical friction.

The bulge at the equator will have a retarding effect on the satellite when it crosses that point twice for each revolution around the earth.

All these influences will eventually reduce the size of the orbit until the satellite finally falls to earth. This latter cannot be controlled by anybody. Let's hope we are not underneath when she comes down.

LAUNCHED AT ANGLE

It is proposed to launch the first satellite at an angle of 40 degrees to the equator. This is the best orbit for convenience of observation by other nations. There will be a line of observing stations in radio contact with each other all along the line of the satellite's orbit.

The satellite will circulate overhead between the 40th latitudes North and South. It will circle the earth in 100 minutes or about 15 times a day.

There have been all sorts of estimates as to how long the satellite will stay up. These estimates run from a few weeks to three years.

A satellite on a large elliptical orbit may stay up for three or more years at a height of 300 miles as its closest approach to the earth.

By launching the satellite close to the equator advantage is taken of the eastern rotation of the earth to aid in getting the required velocity, as every bit of velocity is valuable. The earth will act like a sling, flinging the shot (satellite) forward.

The satellite will be visible to the naked eye under favorable conditions, such as a twilight sky. It will appear like a rapidly-moving weak star illuminated by the sun's rays.

The satellite will most probably be made of some light material, for every ounce will count, particularly if it is to be loaded with instruments.

Even an empty satellite will render valuable information to scientists. Any variation of its orbit with time could yield information about atmospheric densities at high altitudes. Variations of its speed and perturbations of its orbit could be related to the shape of the earth and the distribution of its contained mass, thus making possible more accurate maps.

It is probable that most of the satellites will be manned with instruments specially designed for the purpose. As it is highly improbable that these instruments will be recovered in a serviceable condition when the satellite comes to earth, all the information from any instruments will have to be telemetred to earth and translated.

Power for any batteries will no doubt be gained from storage batteries charged by a new type of solar battery recently developed in the USA. These solar batteries convert the sun's rays into electricity which can be used to charge a small storage battery.

IONOSPHERICS

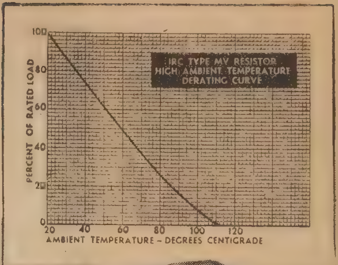
As the satellite will only be in darkness for about half an hour on each trip, the current from the solar battery would be suffiicent to supply enough power to the storage battery to carry on for that period.

One of the most important lines of research to be carried out by means of the satellite is the more complete

(Continued on Page 23)

For HIGH VOLTAGE applications

where high resistance and power are required



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IRC Type MV Resistors are designed for high voltage applications where high resistance and power are required. Unique application of IRC's famous filament resistance coating in helical turns on a ceramic tube provides a conducting path of long, effective length.

Typical applications for which Type MV Resistors are particularly suited are voltmeter multipliers, high resistance standards, bleeders, grid leaks and voltage dividers. MV applications are also found in X-ray equipment, cathode ray tube circuits, off load capacitor discharge in high voltage circuits, photo electrical cell applications, high-range bridge circuits and other electronic circuits.

RATINGS indicated are maximum based on free air operation at 20°C. ambient. **DERATING** curve is available on application. **TEMPERATURE COEFFICIENT:** −.005%°C. for low resistance to −.07%°C. for high resistance values. **HUMIDITY:** General protective coatings of special varnish, baked individually at high temperature, provide protection against the effect of abnormal humidity.

Contact your usual supplier for full details.

Type	Power Rating	Peak Voltage Rating	Minimum Available Resistance at 20% Tolerance	Maximum Available Resistance at 20% Tolerance	Dimensions	
					Ceramic Length	Resistor Body Diameter
MVF	2 watts	5,000	2,500 ohms	250 megohms	1-3/4"	5/16"
MVG	4 watts	5,000	10,000 ohms	700 megohms	2"	9/16"
MVJ	5 watts	10,000	20,000 ohms	1,500 megohms	3"	9/16"
MVP	10 watts	15,000	50,000 ohms	2,000 megohms	4-1/2"	3/4"
MVA	20 watts	25,000	0.2 megohm	4,000 megohms	6-1/2"	1-1/8"
MVO	30 watts	50,000	0.4 megohm	8,000 megohms	10-1/2"	1-1/8"
MVR	90 watts	100,000	1.0 megohm	20,000 megohms	18-1/2"	2"

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Technical Review

A PROJECTED FLAT DISPLAY TUBE FOR COLOR TV

Most people realise the shortcomings of the cathode ray tube as a TV picture display but cannot suggest a practical substitute. This interesting article from Wireless World tells of recent development on a new type of picture tube.

THE idea for a flat television CR tube first came to Dr. Denis Gabor, FRS, in 1952. Since then he and a small team have been working on it at Imperial College, Kensington, with the financial support of the National Research Development Corporation. A complete and working tube has yet to be produced, but a great deal has been done on the development of the individual parts, and the major problems have now been solved. This article, based on a recent Television Society lecture, outlines its principles.

The main interest of the new tube is not only in its flat shape, which allows it to be hung on the wall like a picture, or stood on the mantelpiece, but even more in its advantages as a color tube. It is more complicated than a conventional cone-shaped monochrome television tube, but simpler to make than the known color tubes and offers an even greater simplification in the associated equipment.

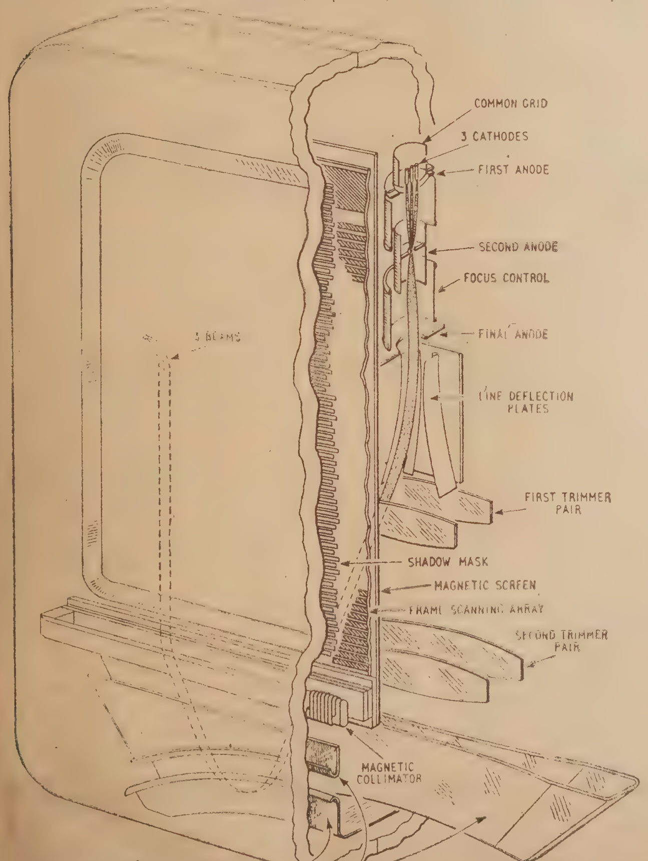


Fig. 1 — Cut-away view of the complete tube.

Fig. 1 is a partly sectioned view of the tube. It has the shape of a flat glass box, almost square. The total depth can be made about 3½in for a screen with a 12in diagonal, and about 4½in for a 21in screen.

DIVIDED TUBE

The tube is divided in depth into two halves by a metal tray which carries the whole electron optical system and serves at the same time as a magnetic screen. The electrons start vertically downwards from an electron gun behind this screen which has three independently-modulated cathodes, one for each color, but with a common lens system for handling them.

The three beams next pass through an electrostatic line deflection system which, of course, deflects them horizontally, then through two "trimmer" pairs of electrodes which serve for compensating misalignments, and from these into the "reversing lens".

This can be considered as a lens with a curved optical axis of very unconventional design, which has four electron-optical functions. It converts the plane "fan" of rays issuing from the line deflector into another plane fan, but with about four times greater divergence.

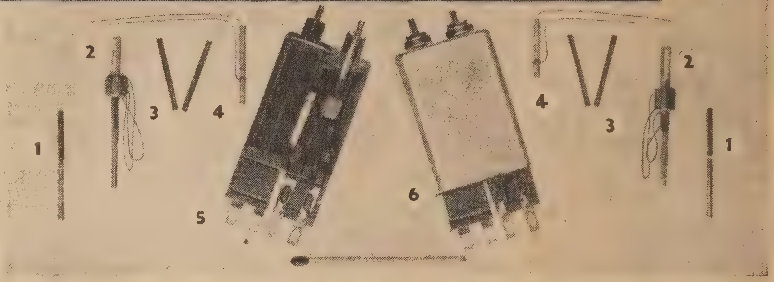
BEAM FOCUS

Moreover, it compensates the overfocusing effect which is inseparable from electrostatic deflections to such an extent that the beam remains in perfect focus throughout the whole scanning of a horizontal line, even though the divergence of the beams after leaving the reversing lens may be as much as 110-120 degrees—an unheard-of large scanning angle in electrostatic tubes.

The beams next pass through a "strong focusing" electromagnetic lens, called a collimator, which bends them back to the vertical so that they perform their scanning motion at the front

5/8 of a cubic inch and a Q of 140

Here is illustrated a Philips Micro 12 I.F. Transformer showing the separation of the various component parts with a match-stick for comparison of size.



"Miniwatt" MICRO 12 I.F. TRANSFORMER

1 This is the tuning core. A FERROXCUBE slug is attached to the coarse pitch tuning screw by a cementing technique.

2 The inductors are wound upon a strip-wound former into which the core assembly has been inserted. The former has a wall thickness of .005 inch; this ensures that the coil is as close as practicable to the core. The thread is formed by applying heat and radial pressure to the former when the core assembly has been inserted. The coils are wound of special litz wire to give low losses and high "Q" factor. The inductance of the coils has a positive temperature coefficient.

3 The Micro 12 I.F. Transformer depends upon many things for its high performance. Not the least of these is the improvement in the magnetic circuit brought about by the introduction of FERROXCUBE rods 1.6 mm. in diameter displaced around the outside of the coils. Coupling between coils is dependent upon the length of the rods and is thus easily adjusted to fine limits in design.

4 Philips have developed a special silvered ceramic capacitor for this I.F. Transformer. It is small in size (2 mm. in diameter) and very stable. Its temperature coefficient is negative.

5 All these component parts are fitted into a Philite moulding and glued into place. The soldered connections are made and the transformer is then ready for tropicalisation.

6 The assembled moulding is then waxed and inserted into an impact extruded aluminium canister.

Every transformer is subjected to electrical and mechanical tests to ensure adherance to the specification laid down by the Components Laboratory.

SPECIFICATION:

- **A.** *Primary capacitor 110 pF.*
- **B.** *Secondary capacitor 195 pF. (Secondary connections are on the side of the canister bearing the part number.)*
- **C.** *Primary and Secondary unloaded Q—not less than 140.*
- **D.** *KQ equals 1.05 ± 15%.*
- **E.** *Frequency drift between 20° C. and 75° C. 5°/cycle/° C.*
- **F.** *Nominal operational frequency, 455 kcs.*
- **G.** *Tuning range of core covers a maximum circuit capacity of 15 pFs.*
- **H.** *Maximum working temperature, 75° C.*
- **I.** *Maximum tolerable temperature, 85° C.*
- **J.** *Insulation between circuits, 200 megohms minimum, after 48-hr. tropical test cycle.*
- **K.** *Volume of I.F. in canister, 5/8 cubic inch.*

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side like vertical rods. Finally, on reaching a certain level the beams are bent toward the horizontal and fall on the screen.

This final bending and the vertical scanning motion is achieved in an essentially novel way, which is illustrated in Fig. 2. In front of the metallic plate, which acts as a magnetic screen, and at a distance of about 1-8in from it, there is a component called the frame scanning array. This is a system of parallel conductors printed on a flexible, insulating base.

In the plane central part of this insulating foil the array consists of horizontal conducting lines. Their number is rather large, about 120, but it has no direct relation to the line number in the picture.

CONDUCTING LINES

At the two sides, where the base is bent round in two U-shaped loops, the conducting lines are staggered upwards as shown.

They are not connected with anything; their charging and discharging is effected by the electron beam itself, as will now be explained.

In operation, a potential wave is made to travel down the scanning array vertically, and the generation of this wave is achieved as follows: Assume, to begin with, that up to a certain level the conductors are charged up to the maximum positive potential. Above this, with a transition zone extending over a few conductors only, they are at about one-quarter of this voltage.

When the beam electrons on their upward travel reach the transition zone, they are bent towards the phosphor screen (which is all the time at the maximum positive potential), and are focused at the same time because, as is well known in electron optics, a strong electrostatic deflection of an electron beam always produces a certain amount of focusing.

When the beam has completed a line scan, after a rapid fly-back, it rests for a moment (5-6 pc of the time) in the loop at the left of the array and falls on the conductors in the transition zone. These are partially discharged, thus moving the transition zone a little downwards. The current is so adjusted that this displacement is equal to one line width in the picture.

Once started, the transition zone automatically runs down as a wave of potential variation until it reaches the bottom of the picture, leaving all the conductors above it discharged and negative.

USE OF SCREEN GRID

The line scan is now stopped so that the beam comes to rest in the bottom of the right-hand loop. This is similar to the other loop, but with the difference that it contains a screen grid, held at maximum positive potential.

At the "writing" point of the beams, secondary emission takes place and the flow of electrons to the screen causes the array conductors at this point to charge themselves up to the positive screen potential. As a result of this, and the "staggered" configuration of the array conductors in the loop, the bending-over point of the beams (determined by the elestrostatic lens action) is moved slightly upwards so that fresh conductors become charged up.

The process continues and the beams travel upwards, successively charging up more and more conductors.

* * *

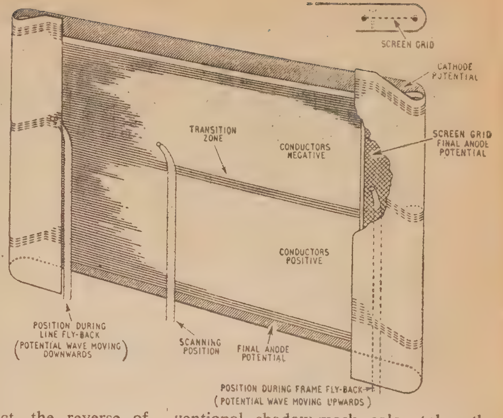
SCREEN GRID
CATHODE POTENTIAL
TRANSITION ZONE
CONDUCTORS NEGATIVE
SCREEN GRID FINAL ANODE POTENTIAL
CONDUCTORS POSITIVE
POSITION DURING LINE FLY-BACK (POTENTIAL WAVE MOVING DOWNWARDS)
SCANNING POSITION
FINAL ANODE POTENTIAL
POSITION DURING FRAME FLY-BACK (POTENTIAL WAVE MOVING UPWARDS)

Fig. 2—Principle of operation of the frame scanning array.

The action is, in fact, the reverse of what happens in the left-hand loop of the array. A transition zone is formed by the conductors being charged up from negative (instead of discharged from positive). This moves upwards (instead of downwards) as the lower positive area of the array is made progressively larger (instead of smaller), by successive addition of charged conductors and the upper area of discharged conductors grows correspondingly smaller (instead of bigger).

Thus, during the frame fly-back interval, the beam travels up the loop to the top, and then the cycle is ready to start again.

This self-scanning process, though it unavoidably makes the tube more complicated, simplifies the circuit work, as there is no need in the receiver for the usual blocking oscillator or multivibrator running at frame frequency.

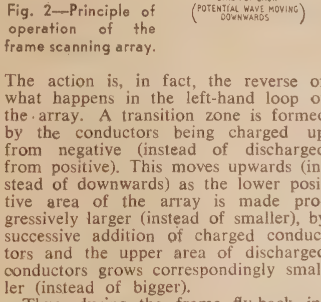

Fig. 3 — Separation of beams at the shadow mask.

(A flat television tube in which the frame scan is effected by a travelling electric wave was independently invented by W. Ross Aiken, of the Kaiser Aircraft and Electronics Corporation, of Oaklands, California. In this tube the scaninng array has only seven conductors, and they are energised from the outside by seven special valves. Kaiser's and the NRDC have pooled the flat-tube patents in a world-wide agreement.)

The line-scanning generator is still necessary, but it requires far less power than the line generator for conventional television tubes.

Fig. 1 shows that the three color beams, issuing from independently modulated cathodes, merge during most of their course. This is an important feature of the new tube. In the conventional shadow-mask color tubes the three beams start from three rather widely separated guns, which aim at one point. This requires great accuracy, which in fact cannot be achieved without a great number of corrections (at least nine), and the adjustment is easily upset by local magnetic fields. (In the new flat tube the three beams stay so closely together that local magnetic fields influence them substantially as if they were a single beam; that is to say, without upsetting the convergence, and their effect (strongly reduced in any case by the effective screening of the central plate) can be easily compensated by the "trimmer" electrodes.

The three color beams separate only just before the final bend, and at the end of this they come together again, but at different angles to the screen. This is the basis of the color control, which is more clearly shown in Fig. 3. It is based on the shadow-mask principle, but with the important difference that, while in conventional tubes the distance of the shadow-mask from the phosphor screen is of the order of ½in, here it is only about 0.025in. (This is made possible by the large convergence angle of the beams and also partly by their slanting incidence.)

SHADOW MASK

Consequently it now becomes possible for the first time to fix the shadow-mask directly on to the phosphor screen and thus avoid all the difficulties which arise in other tubes from the necessity of very accurately aligning two independent, precision-made components.

Fig. 4 shows a suitable design of shadow-mask fixed directly on the screen. A thin metal foil (0.0013in-0.002in thick) is sharply bent in vertical folds so close together as to be invisible to the eye. These folds form ribs for the accurate spacing and fixing of the plane portion which carries a great number of slits, horizontal or slanting (40-60 to the inch).

A slanting angle, as shown, is advantageous for the avoidance of moire effect. The slits are produced by etching, either before or after the mask is fixed on the glass, a "resist" pattern being printed on the metal foil before the folding operation.

The preparation of the phosphor screen, which in present-day color tubes consists of a long series of delicate processes, is very simple. The three finely-

(Continued on Page 23)

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MAN'S FIRST STEPS INTO SPACE

(Continued from Page 17)

investigation, on the spot, of the ionosphere. This could lead to improvement of long-range radio communication.

The earth's magnetic field can also be investigated by means of magnetometers. This is also related to communication.

A photo electric cell in the satellite could make detailed studies of the cloud cover of the earth. The revolving satellite would alternately face the earth and space. Thus the photo cell can make a survey of reflected light below. This would aid meteorology.

The most important study is related to the short wave radiations of the sun, and Cosmic rays. The latter are those mysterious rays which constantly bombard the earth from outer space. Little is known about them or their ultimate effects on life.

SECONDARY RAYS

When these rays reach the earth they are secondary rays. The primary rays are lost in the upper atmosphere. Suitable instruments in the satellite may record these rays and telemeter the information to earth. By comparing the two records the origin and effects of these rays may be determined.

We yet do not know what sunlight is composed of before it enters the atmosphere or how it affects the upper atmosphere. The satellite could be very valuable in getting this information. It may result in more accurate information about the weather and thus to more accurate forecasting.

Ultra violet and x-ray radiations from the sun are absorbed by the atmosphere at high altitudes. This absorption produces chemical activity, heat, winds and electrification of the ionosphere. By instruments in the satellite these could be studied to our great advantage regarding weather, climate and radio communication.

The fringes of our atmosphere are being constantly bombarded by particles of dust and small meteorites. We know little at present about the effects of this bombardment and, as far as we understand, it produces no observable results. But who knows what is happening "up there", which may affect us considerably "down under"?

This rain of particles could easily be recorded in a satellite and by comparing what is going on below with what is going on above we might get surprising results.

In fact, the whole field of investigation is based on a comparison of this nature. Comparing above and below at the same time and noting the effects, the results could prove of incalculable benefit in every way.

A special satellite has been designed to examine the face of the sun. This would be valuable as a more defined examination could take place free from atmospheric disturbances.

This satellite is called the MOUSE (Minimum Orbital Unmanned Satellite of the Earth).

The MOUSE will be spun on a horizontal axis, before take off, pointing to the sun. The satellite will move on a pole to pole orbit in a plane perpendicular to the sun. In this way the horizontal axis, always pointing at the sun, can be used as a transmitting aerial, and can also house certain instruments, which should be kept away from the rest of the satellite.

Any instruments which are to record the sun can be so placed as to always point at the sun, and the resulting energy can be converted into electricity as mentioned above to charge small batteries for other instruments.

STIMULANT TO SCIENCE

The artificial satellite thus promises to be a stimulant to practically every known science. It will undoubtedly benefit mankind in many ways. The experience gained in projecting small satellites into outer space may also well be the forerunner of more ambitious schemes of projecting larger and larger vehicles manned by human beings. It will bring the space ship much nearer realisation than is perhaps thought at present.

In the meantime get ready for watching the sky some time early in 1958.

PROJECTED FLAT DISPLAY TUBE FOR COLOR TV

(Continued from Page 21)

ground phosphors, corresponding to red, green and blue, are dropped vertically from air suspensions through stagnant air on to the tacky surface, at three different inclinations of the screen to the vertical, through the slits of the shadow-mask.

This operation would not succeed at the usual distance (½in) of the shadow-mask, but it gives very sharply defined color strips with a spacing of the order of 0.0025in. One can make the strips 0.005in wide, or even thinner if desired in high-definition television systems.

Two other rather difficult technological problems had to be solved in the development of this tube. One was the preparation of the frame scanning array. A suitable if unconventional insulating support was found in glass fabric coated with a very heat-resisting silicone varnish known as MS994 (made by Midland Silicones). The difficult problem of producing a printed circuit on this material was brilliantly solved by a new process of the Metropolitan-Vickers Research Department.

Another technological problem of considerable importance was posed by the flat screen. If this were made of ordinary annealed glass it would have to be about one inch thick in a 21in tube, which is prohibitive. The difficulty was solved by a prestressing (toughening) process which increases the apparent tensile strength of the glass by at least a factor of three or four.

The electron-optical development, which took up most of the time and is now nearly completed, has so far been carried out in demountable vacuum tanks. Further work is in progress with the ultimate aim of producing sealed-off tubes.

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NEWS AND VIEWS OF THE MONTH

Transistors' long life

REPLACEMENT of transistors in portable radios and other electronic equipment may never be necessary if they are used within the limits set by the manufacturer.

According to overseas reports, life tests started in 1954 on transistors picked at random from regular manufacturing lots show no failures after 18,000 working hours at full power.

This is equal to maximum load on the transistors eight hours a day for six years.

Even now it is impossible to tell if the transistors ever will fail because they look and act like new transistors.

By comparison, specially constructed long life valves, whose duties transistors are fast replacing in electronic circuits, have a survival record of only 50 pc after less than half this time at full power.

Valves used in home radios have an even shorter life.

Results of a check of 2050 transistors showed that only one-quarter of one pc of the transistors could not be operated at peak ratings after 1000 hours at full power.

All of the transistors were still usable in portable radios.

The other 99¾ pc of the transistors tested showed no signs of wear whatever.

In another test to discover how great a shock impact transistors could withstand and still operate reliably, several lots of transistors were shot from a mortar. The shock from such a jolt is equal to 8000g's or sixteen times greater than required by stringent military specifications for transistors. It is reported that 60 pc to 75 pc of the transistors shot from the mortar were still capable of operating at full power. Minor internal structure modifications are now being made to give better survival.

Other tests included evidence that transistors are capable of withstanding substantial doses of nuclear radiation, and the information that germanium transistors are capable of operation at 100deg. C. (212deg. Fahrenheit) and storage at 135deg. C. (275deg. Fahrenheit)

Electronic shunting

THE Societe Nationale des Chemins de Fer Francais, after having beaten the world record for speed (207.5 miles per hour), and being the first to run a train without conductor by remote control at 74.5 miles per hour, recently set a new world record.

For the first time an electronic system for making up a freight train in a relatively short time has been experimented on 100,000 railroad cars during one month. By using herzian waves, a train of 50 cars can be made up, under the poorest conditions, in 21 minutes.

This new system required three years of research. It will be soon completed by a system of transmission by telescriptors, which will instantly give the composition of the freight train to the station of arrival, which will thus be apprised of the freight on the train even before it has left the station of origin.

A big bridge

AT Tancarville, 15 miles above Havre, work has just been begun on Europe's longest suspension bridge.

This will cross the estuary of the Seine in a single stride of 665 yards, at a height of 164 feet above the water. Nearly a mile in length—1542 yards—its width will be 59 feet. Two double pillars, 387 feet high, will support the roadway by cables measuring 2 feet 2 inches in diameter and weighing over a ton to the yard.

Fifteen tons of steel and 58,000 cubic metres of reinforced concrete will be needed, and 15 miles of steel wire a sixth of an inch thick will be used.

Five hundred workmen are being employed on building the bridge, which it is estimated will be 4-milliard francs, some £400,000.000. A toll will be levied, and the Havre Chamber of Commerce will be granted a 75-year concession.

POPULAR SCIENCE QUIZ

Q. How valuable is grass in the scheme of things?

A. Grass, the most stepped-on organism on earth, creates more energy than an atomic bomb—just 700 acres of grass win from sunlight in one day as much energy as that of the standard atomic bomb or 20,000 tons of TNT. Grass is more valuable than gold and as vital to us as air and sunshine. As a tool against floods, grass is 10,000 times more effective than all the dams built by man.

Grasses cover one-fifth of the land surface of the globe. There are 6000 species of grass and more individual grass plants than any other kinds.

Q. Do chemicals necessarily harm foods? Or would we do better to avoid them in the preservation and preparation of what we eat?

A. All foods, as they occur naturally, are mixtures of complex chemical compounds. We would need the space of a good-sized blackboard to list the various chemical formulas contained in an apple.

Moreover food preparations, even of the simplest type, involve complex chemical reactions. Take, for instance, the practice of smoking meat or fish, an art that has come down through the ages. The smoke of slow-burning hardwoods contains a host of chemicals, such as formaldehyde, acetaldehyde, acetone, phenol, acetic acid, methyl and ethyl alcohols and others.

The use of chemical aids in foods is no new phenomenon. It was a well-established practice while food preparation was still largely a home function. Grandma's pantry shelf contained such chemical improvers as: sodium aluminium sulphate, which is simply alum used to harden pickles and in baking powder; calcium acid phosphate, another baking powder ingredient, and sodium bicarbonate, usually called baking soda—as well as such old timers as sodium chloride, our common table salt; acetic acid, a major component of vinegar, and potassium acid tartrate, generally known as cream of tartar.

Ruskin says, "It (cookery) means the economy of your Grandmothers and the science of the modern chemist."

Q. How old are the stars? Are they ageless? Or have they a definite life like other things in the universe?

A. Stars are continually being born, while others die, astronomers now believe.

Investigation and surveys are constantly bringing to light new evidence on the birth and death of stars.

In general, stars seem to separate into two main classes.

One class, sometimes called Population I, is found in the regions of vast dust clouds floating in the outer arms of the Milky Way, the galaxy of stars which includes our own sun and solar system, and in the outer arms of other spiral galaxies.

Population II, on the other hand, is concentrated heavily in the hub of the galaxy's giant wheel, spreading out in a spherical formation from the flat sides of the wheel.

Population II stars are thought to be old, stable suns, perhaps as ancient as the Milky Way itself. Stars of Population I, on the other hand, are believed to be comparatively young.

Some of the brightest stars known, the so-called "blue giants", belong to Population I. They expend their energy so fast that they cannot live long—only a few million years. If they were as old as stars of Population II, they would have burned themselves out long ago.

As they do die out, the sky survey astronomers think, perhaps others are being created—born from contracting clouds of matter in interstellar space.

Quick diagnosis

DOCTORS may soon be able to diagnose diseases before the sickness sets in.

This is predicted by cancer research specialist Dr. Felix Wroblewski, of the Sloan-Kettering Institute, Washington.

New era in medical diagnosis hinges on a simple technique of measuring the enzyme levels in the body fluids.

An enzyme is a substance which triggers chemical reactions in the body without being used up in the process.

Dr. Wroblewski has reported that enzyme tests could uncover body ailments at the beginnings of their most treatable or preventable stages.

HEPATITIS

Already, Dr. Wroblewski pointed out, there are enzyme tests which enable a doctor to diagnose infectious hepatitis (contagious jaundice) four to six weeks before there is any sickness or other evidence of the disease.

In a report Wroblewski said that it has been known for 25 years that certain enzymes are normally present in greatest quantity in bone and pancreas respectively.

But recent studies have uncovered a number of other enzymes which are released into the blood and other body fluids in abnormal quantities when disease is present.

Careful tests show that these enzymes are released in varying quantities depending on the severity and type of the disease affecting the organ with which they are associated.

Heart disease, blood clotting in the vital coronary arteries and death of heart muscles, he noted, caused a rise in blood levels of several enzymes.

Record air drop

THE United States Air Force's new medium troop and cargo carrier, the propjet C-130A Hercules, has successfully dropped the heaviest single load ever extracted by parachute from an aeroplane.

A 27,000-pound (12,227 kg.) load was extracted from the turboprop Hercules during aerial delivery tests at El Centro, California. Naval Auxiliary Air Base.

At least two new world's records were established during the tests — for heaviest single load, and for biggest multiple drop ever accomplished from an aeroplane.

The air freighter, soon to enter active service with the Air Force's Tactical Air Command, made aviation history in a series of 37 parachute drops, including aerial delivery of a huge road-grading machine—such as moves earth in construction of superhighways—and a 400mm. gun mount.

Heaviest single item to be yanked by parachute from the cavernous C-130, was a 27,000-pound dummy load of iron, its load-carrying platform and six 100-foot cargo parachutes, which were necessary to float it easily to the ground.

Radio most popular

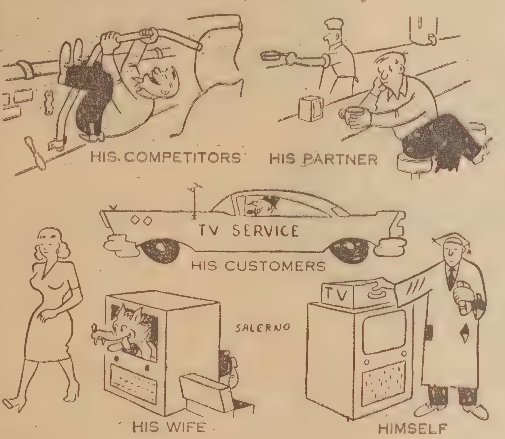
LISTENING to the radio is our chief leisure-time occupation, the Gallup Poll finds.

Throughout Australia, people were handed cards, listing six ways of spending spare time. They were asked which was their favorite way of spending their evening leisure, both Saturdays and week-days.

Answers show radio as top favorite, both on week-day evenings and Saturday evenings. During the week reading is second favorite, but movies are second on Saturday evenings.

If radio plus movies equals TV, then the prospect looks bright.

THE TV SERVICE TECHNICIAN AS SEEN BY . . . .



EVENING LEISURE

	Week days	Saturdays
	pc	pc
Favorite		
Radio	39	26
Movies	8	19
Reading	25	17
Visiting	5	14
Cards	5	8
Dancing	2	5
Working	5	3
Others	11	8

Sealed circuits

AN American firm, Doty Acoustical Electronic Laboratories, has available potted and sealed transistor circuits such as flip-flop, multivibrators, d-c amplifiers, audio and r-f oscillators, saw tooth generators, gates, inverters and similar units.

The units can be used as a plug-in or may be soldered into bails to form computers or allied electronic circuits.

Their versatility makes it possible to break any existing electronic equipment into separate component stages.

Dimensions: Minimum size is 0.313 long by 0.717 wide by 0.312 high; average—0.750 by 0.717 by 0.312; maximum—1.500 by 0.717 by 0.312.

National Bureau of Standards circuitry is used, or special circuits can be made to user specifications.

Experience proves "BELLING-LEE" TV Aerial Systems to be superior

In many areas where topographical features or electrical interference have caused poor television reception, the "Belling-Lee" Double 'V' TV Aerial has proved its superiority by producing clear trouble-free sound and vision.

The "Belling-Lee" Double 'V' aerial has a sharp forward lobe and an excellent front-to-back ratio. The forward gain lies between 1.5 dB on Channel 2, and 7 dB on Channel 9. An outstanding feature is the excellent voltage standing wave ratio on the 300 ohm feeder, which varies between 2·2:1 and 4·1:1 maximum, thus offering a truly low-loss transfer of energy to the receiver.

Television Engineers have repeatedly found that wherever poor television reception is being experienced, a "Belling-Lee" Double 'V' TV Aerial System greatly assists in rectifying the trouble. The Double 'V' gives a high-gain aerial system at very moderate cost, and has proved to be a winner for country districts.

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"Belling-Lee" were the first company to produce the Double 'V' aerial in Australia. There is no substitute for genuine "Belling-Lee" TV aerials.

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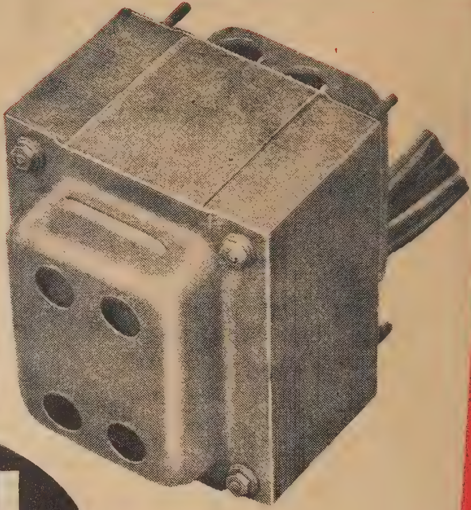
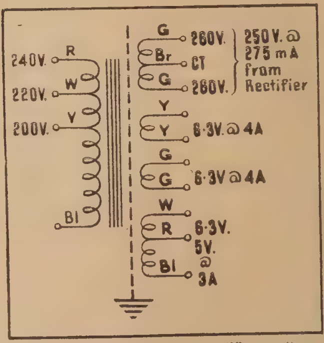


National TV POWER TRANSFORMER

TRANSFORMER TV275/260
Dimensions (upright mounting):
$4\frac{1}{2}$" x $3\frac{3}{4}$", stack $2\frac{3}{4}$"



With directly heated filament rectifiers, voltage at rectifier is 225 volts DC, and with indirectly heated filaments 250 volts DC approx.

for these 8 reasons

PRODUCTION FACILITIES

1. NATIONAL is the largest T.V transformer manufacturer in the Commonwealth with a modern, mass production factory capable of supplying the full requirements of T.V. Quality controls ensure uniformity of production in each particular line NATIONAL'S experience and specialised development benefit Manufacturers.

TECHNICAL FEATURES

2. Designed to operate at low flux density thus reducing interference to picture tube.

3. Electrostatic shield between primary and secondary minimise line pick-up.

4. Fitted with copper strapping to reduce external field.

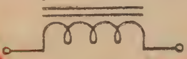
5. 'Rolled-edge'' holes in cover prevent chafing of leads.

6. Unique lead-anchoring inside the core prevents leads being pulled out

7. Air-cooled scientifically. Louvres and vents in the cover provide maximum cooling.

8. Low temperature rise reduces the ambient of the TV receiver chassis

CHOKE TV3/275
Dimensions:
$3\frac{1}{8}$" x $2\frac{5}{8}$" x 2" coil width



National TV Choke

- Inductance—3H.
- D.C. Resistance—70 ohms.
- Current Rating—275mA.
- Fitted with easy-mount clamps.

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New 12-volt valves

IT is interesting to note the efforts being made overseas to power radio devices from very low voltage sources.

The appearance of the transistor has no doubt had a good deal to do with this, and has focused attention on the problem of carrying out electronic jobs more economically.

For instance, the USA has recently seen a new series of valves designed to operate from a single DC source of 12 volts.

The immediate use for such valves is the car radio market, which is a very large one. The tendency now in America is to fit all normal cars and trucks with 12-volt systems instead of the 6-volt types which have been standard ever since cars carried batteries.

There has also been a further standardisation in grounding the pole of the battery. In the past both negative and positive poles have been grounded, in different cases, a practice which would make it almost impossible to derive a positive connection for high tension.

The advantages of a 12-volt receiver are very great. There is no need to use a vibrator supply, which generally involves a rectifier as well. Wiring is simplified, because all filament and high tension circuits run to a common point.

The output stage uses a power transistor for which a 12 volt supply is quite adequate.

Solar powered set

ANOTHER development which might yet have a very considerable impact on design is the Admiral company's sun-powered portable set.

It looks much like any other set, except that it has a solar-cell unit which is exposed to sunlight when the set is working.

In fact sunlight isn't a necessity. According to reports there is enough output from the cell to operate the set on overcast days or even from an electric lamp.

The power unit supplies 9 volts at 15 milliamps, and the receiver uses six transistors in place of valves.

Such a set is worth about £150, most of the cost being in the power unit. This uses a quantity of silicon which is extremely expensive in its pure state.

DX reception of TV

ALMOST daily reports are being received of consistent TV reception over comparatively long distances.

Some of these are well over 100 miles and there are bound to be more of them as more TV sets come into use.

So far we have not heard instances of pictures having been interchanged between the capital cities as could quite easily happen particularly during the summer months.

But by the time the next DX period comes around there should be enough TV activity to make things quite interesting in this direction.

Channel 1, not yet in use, is the one most likely to provide long reception hops.

Australian amateurs on their old 50 Mc band frequently filled the area between New Zealand, Brisbane and Perth with very strong signals obtained from a few watts of power. Nor were directional aerials particularly effective when the bands were open.

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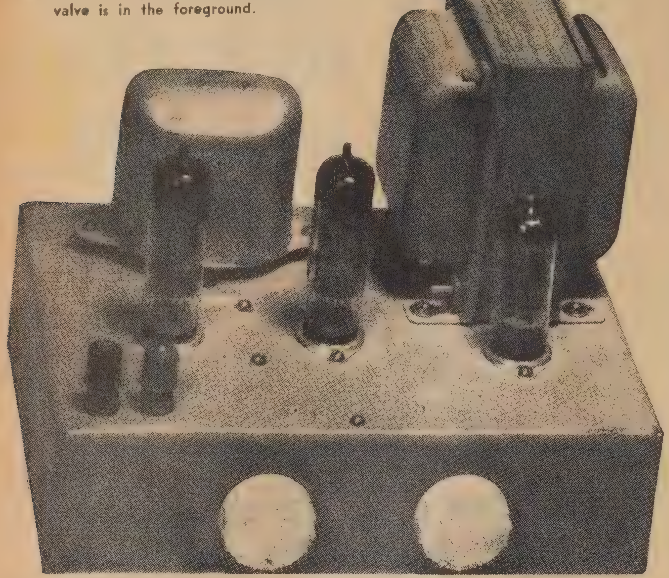
F133



A photograph of the completed amplifier illustrating its compactness. Economy of space is achieved by using a minimum of components and dual purpose valves. The valves, left to right, are V2 and V1 respectively. The rectifier valve is in the foreground.

LOW COST CRYSTAL AMPLIFIER

By making use of a new combination triode-pentode valve, we were able to build this excellent little amplifier of moderate but useful power and extreme simplicity. It is intended primarily for crystal pickups—just the thing for a dance or a swing session. It's cheap to build, too, because there are so few parts to buy.

by Wes Yashin

THERE has always been a steady demand for simple amplifiers of moderate quality and output, suitable for use with record-players or changers equipped with crystal pickups such as are being sold in a wide range of makes.

Not everybody requires hi-fi—plenty of people use their amplifiers for dancing and popular music where the audience isn't interested in playback curves and flat response, as long as the sound is good.

Often such amplifiers have to be assembled with a very cautious eye on the chequebook. Price and simplicity are quite important factors.

PRICE AND SIMPLICITY

In past issues, we have featured a number of these amplifiers, and they have always been popular. But there is always a better and less expensive way of doing a job if we keep an eye on the possibility of using new materials and new ideas.

The release of the 6BM8 valve, which combines a voltage amplifying triode and a power pentode in a single envelope, suggested itself as a most fruitful source of experiment and possible use in an economical circuit.

The 6BM8 was primarily designed as a frame-blocking oscillator and frame output tube for use in television receivers. However, reference to the tube characteristics revealed that it can be used for audio work under various ratings.

Quite obviously we were attracted by the possibility of using the voltage and power amplifying sections in some combination which would reduce the number of valves required to a minimum.

For instance, a single 6BM8 can be used as a two-stage amplifier, the triode as a voltage amplifier and the pentode as an output stage.

If we had two such valves, we could now use the pentodes in a push-pull or parallel output circuit, and the two triodes to drive them. Normally, any such circuit would require four valves, or three, if we employed a twin-triode.

The characteristics of the triode section are quite good — it has a mutual conductance of 2200 and an amplification factor of 70. In a conventional circuit with 250 applied volts to a plate resistor of .1 megs and a high resistance following grid circuit, it will give a useful gain of nearly 60 times, and an output of nearly 40 volts.

The pentode section has average sensitivity and a mutual conductance of 7500. With an applied voltage of 250, it will give an output of 3.5 watts with a plate current of only 28 mills. and a signal input voltage of 11.5. Grid-bias is 19.2 volts and distortion 10 per cent.

MODERATE CURRENT

The comparatively low cathode current of the pentode is quite attractive if we consider a push-pull circuit, for we can expect a nominal output of 7 watts for a total drain of about 65 mills, inclusive of screen current and a fraction of overbias might even improve on this result, and allow us to use a 60 mills power supply without running into trouble.

The valve arrangement suggested itself immediately. One triode was to be used as a voltage amplifier, the second as a plate-cathode phase-changer, and the pentodes connected in push-pull.

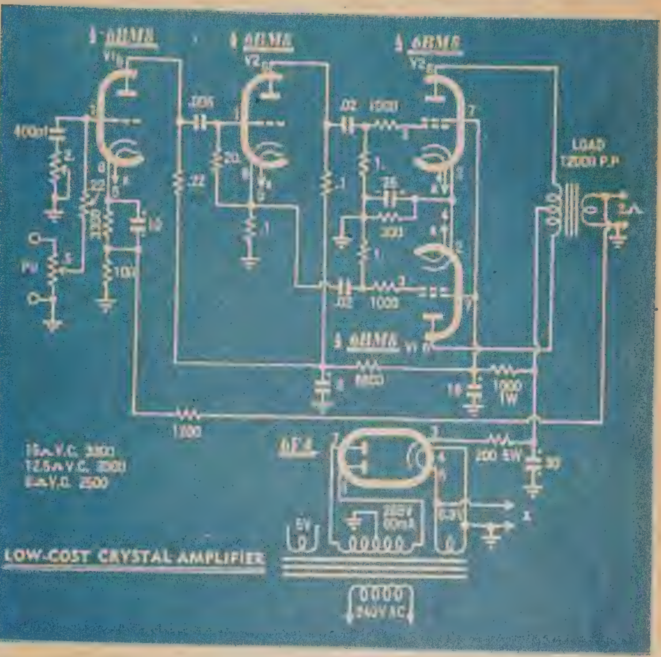
Since the phase-changer does not contribute to the gain, the voltage available to drive the output valves will depend on the output of the first stage.

According to valve data, we should drive these valves with about 23 volts, grid to grid, which means that only about half that voltage will be required from the first triode. This it can provide quite easily with a very small input voltage and with enough in hand to allow a useful amount of feedback to be used. W did not anticipate any trouble in ob taining all the initial drive we coul wish from a crystal pickup.

TRANSFORMER IMPORTANT

And this is the way it worked out i practice. The circuit gave us no troubl at all when converted into a practica form, and we were able to get full ou put with about .25 volts input.

CIRCUIT OF THE AMPLIFIER



The circuit is novel only when we realise that the whole thing is done with only two valves and a rectifier. The design assures the use of a crystal pick-up.

The amount of output will depend quite noticeably upon the quality of the output transformer used. With a good one such as is normally used for better class amplifiers, up to 6.5 watts can be had at the output secondary, indicating that the nominal 7 watt figure was reasonably attained.

With a cheap transformer, having much lower efficiency, output may well drop to 5.5 watts at 1 Kc, which is a price we must pay to save our money.

The better quality transformers should hold their power output figures quite well between say 50 cycles and 10 Kc, but one cheaper type we tried, although holding fairly well at 50 cps showed a power drop at the top end.

Here again the builder must cut his cost to suit, although it is surprising how good even the cheaper transformers can sound in everyday use.

DISTORTION

It's not very profitable to discuss square wave tests on an amplifier of this type, because we know in advance that unless the better-class transformer is used, they won't be very good. Our tests only confirmed this fact but for once we didn't think it very important.

Distribution figures at full output are not likely to compare with the hi-fi designs and the valves themselves are rated at 10 pc for full output single ended. Push-pull operation would greatly reduce this figure, as would the use of feedback, and the total result should once again come within our ideas of acceptable performance.

There is nothing unusual about the first triode stage, and it does not appear to matter much which one is used in this position. Play safe, however, and don't depart from our layout just to be different.

Most records these days are LPs and some high note compensation will be required to reduce the top end during playback.

A simple top cut filter has been introduced in the grid circuit to give a variable amount of treble roll off and it amounts to 20 db at 10 Kc in the maximum position.

SIMPLE COMPENSATOR

Such a simple compensator is permissible where an ordinary crystal pickup is to be used, as it is quite hopeless to apply standard compensation when the pick-up response is so variable. Far better to adjust the tone control for best results and leave it at that.

Owing to the nature of the crystal pickup, no compensation is normally needed at the bass end.

The older 78 records generally sound best with some top cut, and once again you would pick the setting which sounds best.

In the circuit an isolating resistor is used in series with the grid to prevent interaction between volume and tone. The presence of all this grid resistance with a high-mu triode introduces our old friend Miller effect and, even with feedback, it knocks a couple of db off the 10 Kc end. As we are designing for some top cut anyhow, it doesn't much matter whether some of this is attributed to Mr. Miller, but it's an interesting point.

The phase splitter is extremely simple, and has only three resistors. A very high grid resistor does two things. It allows the highest gain from the previous stage, and it provides automatic grid bias by utilising the contact potential effect in the valve itself. Fewer components save money—even the coupling condenser may be of a lower value due to that 20 megs.

Modern resistors are much more reliable in these higher values than they used to be, and this type of circuit is used quite frequently today.

The output stage is conventional, although the screens are fed from a decoupled source to reduce hum danger from the simple power supply. A common bias resistor is used, and grid suppressors fitted as a precaution against parasitic oscillation. But at no stage did we strike any trouble from this source.

Feedback runs from the secondary of the output transformer to the first triode stage in the now familiar manner. About 10 db is used, enough to lower the output impedance by a valuable amount, and to reduce distortion to about one-third of that without feedback.

From a stability viewpoint, we found it possible to use up to 20 db of feed-

PARTS LIST

1	Chassis 8x6x2 inches.
1	285/60 mA power transformer.
1	Speaker transformer (approx. 12,000 P-P)
3	Noval sockets.
1	4-pin miniature plug and socket.

RESISTORS

2	10 meg ½ watt.
2	1 meg ½ watt.
2	.22 meg ½ watt.
2	.1 meg ½ watt.
1	3,300 ohm ½ watt.
1	6,800 ohm ½ watt.
1	1,200 ohm ½ watt.
2	1,000 ohm ½ watt.
1	100 ohm ½ watt.
1	1,000 ohm 1 watt.
1	300 ohm 3 watt.
1	200 ohm 5 watt.
1	2 meg potentiometer.
1	.5 meg potentiometer.

CAPACITORS

1	30 mfd 350 volt electrolytic.
1	16 mfd 350 volt electrolytic.
1	8 mfd 350 volt electrolytic.
1	25 mfd 40 volt electrolytic.
1	10 mfd 40 volt electrolytic.
2	.02 mfd 400 volt paper.
1	.005 mfd 400 volt paper.
1	400 pf mica.

VALVES

1	6V4, 2 6BM8.

SUNDRIES

2 knobs, 2 terminals, nuts and bolts, solder lugs, hook up wire, tinned copper wire, spaghetti, 3 7-lug strips, 2 3-lug strips, a length of 3-core power flex and a 3-pin power plug.

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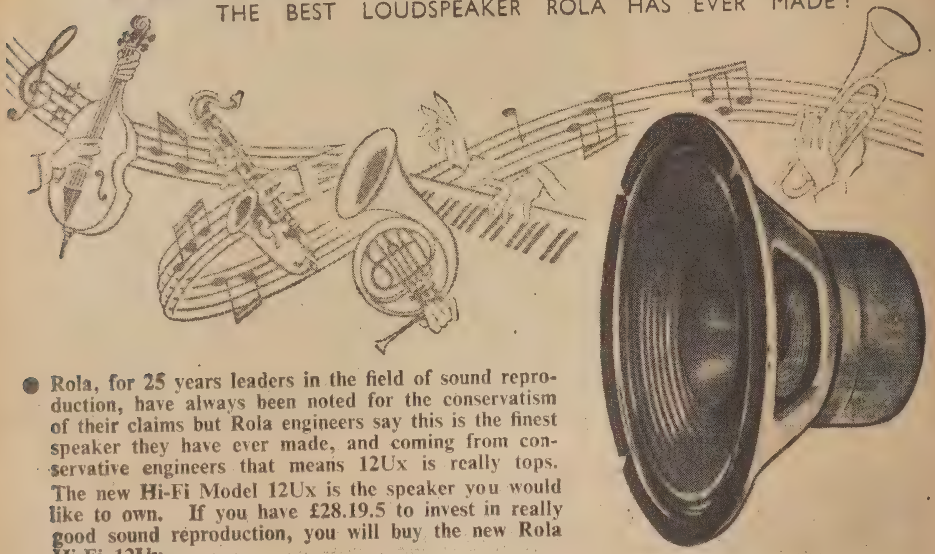

- **Rola, for 25 years leaders in the field of sound reproduction, have always been noted for the conservatism of their claims but Rola engineers say this is the finest speaker they have ever made, and coming from conservative engineers that means 12Ux is really tops. The new Hi-Fi Model 12Ux is the speaker you would like to own. If you have £28.19.5 to invest in really good sound reproduction, you will buy the new Rola Hi-Fi 12Ux.**

  Its brilliant transient response will bring to your living room every delicate nuance of the original sound—the booming of the tympanis, the realism of clashing cymbals, the tinkling of the triangle.

- **If you are interested in technicalities, here are the details:**

Frequency response — 40-14,000 c.p.s. flat ± 6 dB

(Usable response to 30 c.p.s. in the Rola recommended vented enclosure).

Power handling capacity — 20 watts

Intermodulation distortion:
(F1/F2 ; 45/7,000 c.p.s. ; Ratio 1 : 1) — Less than 2% at 20 watts output

Voice coil impedance — 15 ohms at 400 c.p.s.

- *But it is your Ear that is the Final Judge*

Hear the Hi-Fi 12Ux and you will agree with us that Rola has produced Australia's finest loudspeaker—a speaker which will more than hold its own in world competition.

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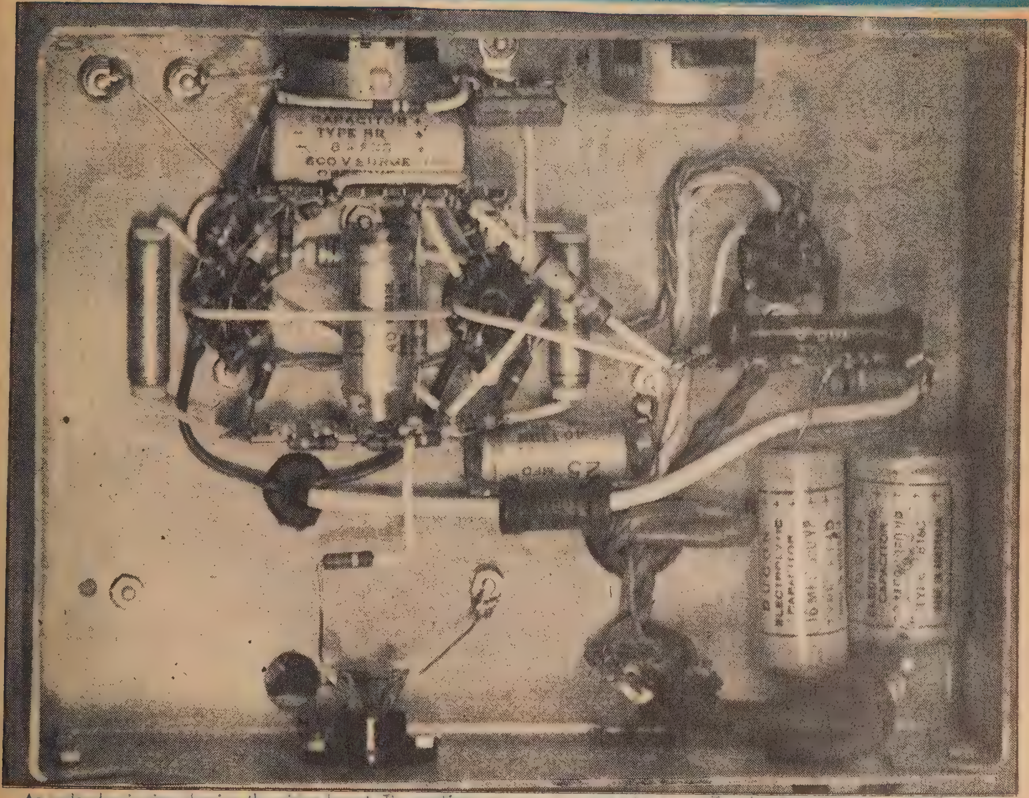
UNDERCHASSIS PICTURE SHOWS ALL COMPONENTS



An underchassis view showing the wiring layout. The markings on many components are self-explanatory. We suggest that you adhere to our layout as any variation may cause instability.

back without striking trouble, but this is not really advised, and the input sensitivity will, of course, be reduced.

The output transformer shown in the photographs is a Rola, but there are other makes comparable in quality and price.

It is not possible to give a value of feedback compensating capacitor which will suit every type of transformer, but the values we have suggested should be safe enough. Too large a capacitor will almost certainly produce oscillation, and with cheaper transformers it is hardly worth while using any condenser at all as the gain at higher frequencies is comparatively low.

We have suggested a load of 12,000 plate-to-plate in the absence of valvemakers' recommendations. It should be OK to go as low as 10,000 ohms if necessary as high grade transformers do not normally come higher than this. There is room on the chassis to mount most types of transformers up to about 10 watts rating.

A feature of the amplifier is its economy and therefore we used a very simple power supply.

The power transformer itself is rated at 60 mills, which is almost exactly the current drain of the amplifier. In this case a few mills over the edge we thought permissible, particularly as we did not use condenser input to the filter.

Hum level is kept quite low by concentrating on decoupling the early stages and using high value electrolytics. This allowed us to omit a filter choke, a practice followed by quite a few amplifier builders, and it also meant removing quite a few shillings from the purchase price. Although we require only about 250 volts for the amplifier, the lack of condenser input required a 285-volt per side transformer to make up the voltage lost thereby.

As a matter for the record, the amplifier showed 250 volts between screens and chassis, 230 volts between plates and cathodes of the output valves, and 19-20 volts across the cathode resistor. Total current drain was about 64 mills. These voltages were measured with a standard multimeter.

As previously mentioned, the omission of the filter condenser following the rectifier reduces the peak current demands on the supply and allows us to safely draw a current higher than normal from it.

The hum level we found to be quite low — inaudible unless you went listening for it in a quiet room. It would have no chance against the quietest music.

Almost any type of speaker will do with this amplifier, although it suggests a 10 or 12 inch type with a rating between 5 and 10 watts. With an ordinary crystal pickup and output transformer it is scarcely worth while spending money on a high-class job. But don't overlook a decent baffle or enclosure if you want to get the best results.

Altogether, we were well pleased with the neat result of our work. The design is undoubtedly simple — it is hard to imagine a method of getting as many good watts from so few valves. Its general quality is quite adequate for everyday work, with everyday speakers and pickups, and if you have a good transformer handy it is good by any standards. All the parts are easy to get, and we have kept them down to a minimum.

And, after all, that's exactly what we set out to do.

Now for some constructional details. The chassis was bent up from 16 gauge aluminium, but 18 gauge aluminium or steel will do. Blueprints for the chassis will be available in the normal manner.

The mounting of the major components is clearly visible in the reproduced photographs and requires no comment. No difficulty should be experienced in the placement of the minor components as there is adequate space. The coded

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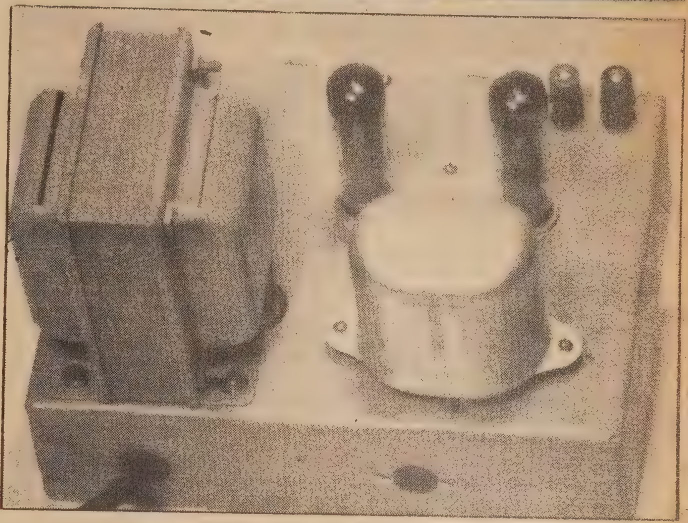
REAR VIEW OF THE AMPLIFIER



A rear view of the amplifier showing the simplicity of the layout. We used an ordinary speaker transformer but there is adequate space for a larger unit if necessary.

under-chassis photograph that we have prepared should be an aid to keeping the layout neat.

Most of the wiring associated with the 6BM8 valves is supported by two 7-lug mounting strips located centrally in front and behind the valve sockets. Point-to-point wiring was used and neatness retained by keeping the smaller components on the square.

For the wiring runs we used spaghetti-covered tinned copper wire, but ordinary hook-up wire will do. Looking over the forward edge of the chassis at the nearest 7-lug strip, the lugs, from left to right, are used for the following connections: Lug 1 is a junction for the .02 mfd. coupling capacitor from the cathode of the phase-changer to the grid of the output valve. Connection to the cathode is by means of spaghetti-covered tinned copper wire or hook-up wire.

Lug 2 is the feed point for the plate supplies of the first two stages. One end of the decoupling resistor and its bypass anchor to this lug. The plate load of the first stage is connected between this point and the appropriate lug on the socket. A lead joins Lug 2 to Lug 5, and the phase-changer plate load is connected between the latter and the appropriate lug on the socket.

ANCHOR POINT

The third lug is an anchor point for the bias-resistor of the first stage and its bypass. A lead joins this lug to the cathode pin on the socket. Lug 4 is an earth lug, and is not used, while Lug 5 has been mentioned.

The sixth lug is a junction for the series connection for two 10 meg. resistors which make up the 20 megs required for the phase-changer grid leak. The two free ends of the resistors are connected between the grid and cathode pins on the socket.

Lug 7 is used as a convenient earth point, and on it terminate the earthy ends of the 8 mfd. bypass in the decoupling network, and the cathode load resistor of the phase-changer circuit. The earthy input terminal connects to this lug and a length of tinned copper wire joins this point to an earth lug under one of the socket mounting nuts.

Looking at the other 7 lug strip, the first lug is an anchor point for the grid-stopper, the grid leak, and the grid end of the coupling capacitor. Lug 7 is likewise used for the same components in the grid circuit of the second output valve. The two grid leaks are connected between these lugs and the centre lug, which is earthed.

SECOND LUG

The second lug is a junction for the cathode end of the bias-resistor of the output stage, and the leads which complete the connection to the cathodes. Lug 3 is the anchor point for the earthy end of the bias-resistor of the first stage and its bypass, the top end of the 100 ohm resistor in the feedback network, and the feedback resistor.

Lugs 5 and 6 are not used. The third 7-lug strip is used to anchor the filter components, and should not require a detailed comment, being easy to follow from the under-chassis photograph.

Two 3 lug strips are also used, the first to provide anchor points for the components associated with the tone control, and the other to anchor the incoming AC leads and the transformer primary leads.

BIG CHANGES AHEAD FOR CARS

(Continued from Page 7)

to squeeze together against the opposing action of a set of springs. At low engine speeds the bob-weight action is not sufficient to close the clutch but when the driver presses down the throttle, the increased rotation of the clutch puts the centrifugal unit into action.

Unfortunately, this is not sufficient to make the action completely automatic, as there is no provision for gear-changing at high speeds. A servo system is therefore added to the unit, so that power from the engine's manifold is used to operate the clutch.

This is effected by a button switch built into the top of the gear lever. The motorist presses this switch at the same time as he changes gear and the clutch action therefore becomes simultaneous with the gear shift.

A final innovation for 1957: At last the manufacturers of Detroit are turning to unit construction, the basic principle of nearly all European cars. Until very recently all American cars had a separate chassis and body. For 1957, both Nash and Hudson have introduced integral construction, resulting in a lighter, more rattle-free design. The success of these new Nash cars has led many observers to believe that other Detroit manufacturers will follow suit next year.

AMPLASOUND CO.

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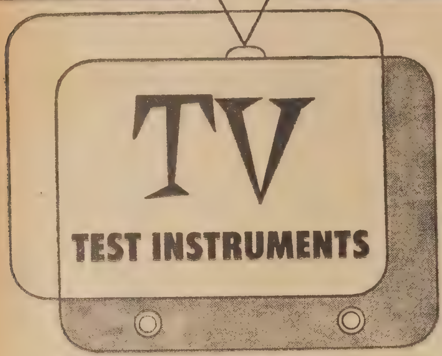

TV TEST INSTRUMENTS

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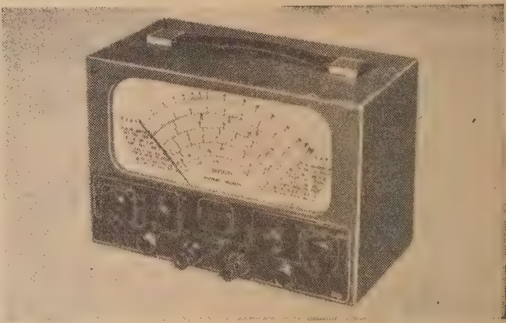

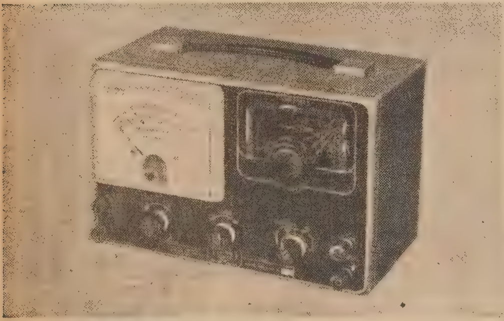

Oscilloscope 3-inch, Model TVR/C3 (below)

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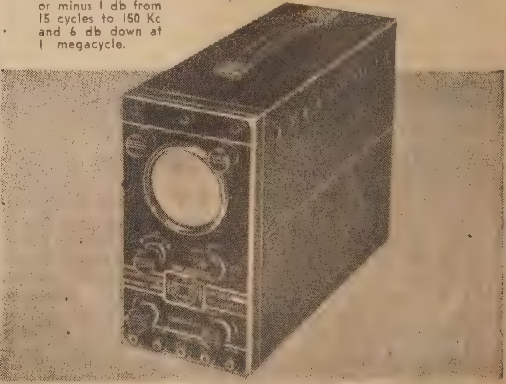

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His books on loudspeakers, amplifiers and pianos have likewise found their way far beyond the Wharfedale speaker works and have totalled the impressive figure of over 100,000 copies.

His new book, while it touches on much of the material already published, presents it in a number of chapters designed to help the reader who, having become interested in hi-fi, finds himself faced with the need for advice on its every aspect.

BASIC INFORMATION

He is, of course, interested in the equipment, so Mr. Briggs has told him the basic things he should look for, and related them to the amount of money available. Turntables, loudspeakers, pick-ups and amplifiers are summarised in general terms, together with some pertinent and easy-to-understand figures and illustrations to point his remarks.

But the enthusiast must know something about the records themselves, their recorded characteristics, how their grooves stand up to wear, and how to look after them. He is given a quick run through the instruments of the orchestra, their frequency range and so on. And there is some highly interesting information about the author's experiences of giving concerts in these large halls—invaluable comment because no one has put so much time into this method of comparison between actual and recorded sound.

Furthermore, although Mr. Briggs makes loudspeakers, do not imagine he is so foolish as to make his book a left-handed catalogue. Naturally he has used his experimental results to illustrate his points concerning them, but what he has written is as applicable here as it was in the country of origin.

Illustrations are profuse, ranging from those extraordinary microphotographs of record grooves by C. E. Watts to some amusing cartoons borrowed from here and there, often as pointed in comment as the text.

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FROM THE SERVICEMAN WHO TELLS

Few things make a better serviceman story than a tricky intermittent. Add a mysterious interaction effect from a domestic sink heater; take away all your serviceman's equipment except a multimeter and simple tools, and you have all the ingredients for a first class technical who-done-it. (Or should I say; what-is-it?)

SOMETHING like this situation occurred to me recently during one of the holiday breaks. I was visiting a friend who dabbles a little in radio and, just as soon as we were able to shunt the ladies—and their meaningless chatter—into another room we settled down to discuss really worthwhile subjects.

Inevitably, of course, the subject turned to radio. Apologising for "talking shop" on a holiday, he confessed that he had an intermittent on his hands which was getting him down.

It was in his own mantel set, a simple four-valve unit he had built himself for use in the kitchen, and the story he had to tell was rather a strange one.

"BITZA"

The set was something of a "bitza", having been built from odd parts he had acquired over the years, some of rather uncertain origin. Nevertheless, it had performed well for several years and had only recently started to give trouble.

This took the characteristic form of a sudden change in volume, usually initiated by the operation of some electrical appliance, such as the "fridge" cutting in, a light being switched on, or something of a like nature. At the same time there was a steady background of spluttering and crackling which sometimes threatened to drown the program.

At first, the trouble could usually be cured by simply switching the set off and on again quickly. While this was so, my friend confessed, he was content to take the easy way out, "duck-shoving" the job of really tackling the problem.

Slowly the situation deteriorated, the set becoming more and more stubborn and less responsive to the "switch off-switch on" technique. The fault was also occurring more frequently and my friend decided it was time to tackle the thing.

ATTACKED IT

So he took an evening off, removed it from the cabinet, took it into his workshop, and commenced probing. As so often happens, the set flatly refused to misbehave, while its true performance was to some extent masked by the presence of a more efficient aerial in the workshop. My friend had no signal generator and the net result of all his checking was rather inconclusive. Tired and somewhat fed up, he put the set back in the cabinet and went to bed.

Strangely enough, for the next couple of weeks the set behaved itself, then commenced its old tricks again. My friend had neither the time nor the inclination to tackle it again just then, so it limped along for several more weeks, to the irritation of the rest of the household.

Eventually it became so bad that my friend realised that he could not put off tackling it much longer—until he made another interesting discovery. The set was operated from one of two power points located side by side. The other point was used for the sink heater which was normally plugged in and switched on all the time.

On one occasion the set seemed to be responding to the operation of the thermostat in the sink heater, so my friend unplugged the latter. Immediately the volume jumped from a whisper to a roar, but dropped again when the heater was plugged in.

A MYSTERY

My friend found this both puzzling and annoying. It was puzzling because there seemed to be no logical explanation of the phenomenon. The sink heater was checked for electrical defects, but nothing whatever could be found wrong with it. Nevertheless, it never failed to lift the volume whenever the set had one of its cranky fits.

And it was annoying because, while there was a method of making the set play at all, my friend found he lacked the urge to find out what was really wrong. Furthermore, the habit of unplugging the heater led to some disruption in the household. On more than one occasion it was accidentally left unplugged for long periods, bringing the wrath of his better half down on his head.

Thus my friend was glad of someone in whom he could confide. As he summed it up: "I'll have to either fix the set or throw the sink heater out and instal a hot water system—and that seems to be an unduly expensive solution to the problem!"

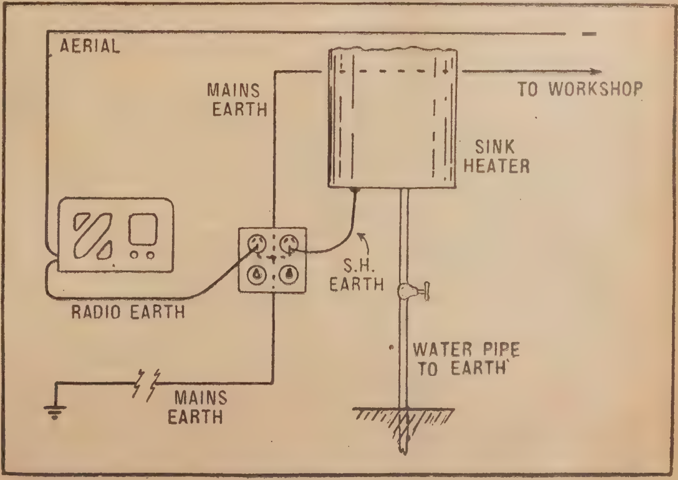
I agreed that it did seem to be going to extremes, and suggested we have a look at the offending set. Just the same, with nothing more than a multimeter and a few minor tools, I did not feel especially confident. I could only hope that the fault would stay in evidence long enough for us to come to grips with it.

My friend switched on the set, waited for it to warm up, then tuned across the band. "It seems to be working OK at the moment," he commented as each of the local stations came in at good strength, adding, "—we might have to wait for it to fail."

FAILED QUICKLY

We did not have long to wait. The "fridge" cut in a few moments later and the volume dropped to a whisper. What was more, no amount of juggling of switches or physical violence on the set itself seemed to have the slightest effect. Even when the fridge cut out again the volume was not restored. This was a most important point which I noted with interest.

"This is the only way I can make it work," said my friend, grasping the sink heater plug as he spoke and pulling it out of the power point. The volume immediately returned to normal, but dropped again as he replaced the plug.



Why the sink heater affected the radio. When plugged in it provided a short, direct, earth but, when unplugged, the earth lead was as long as the aerial. The extra signal so provided helped to offset the losses in the set.

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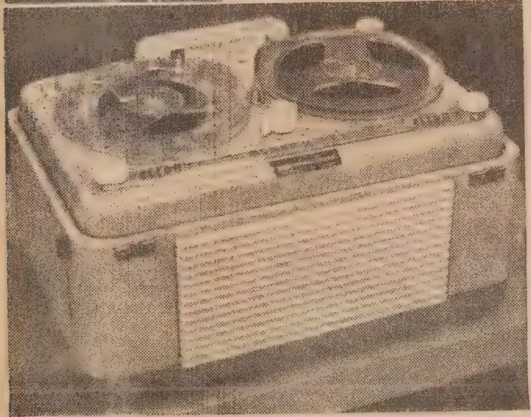

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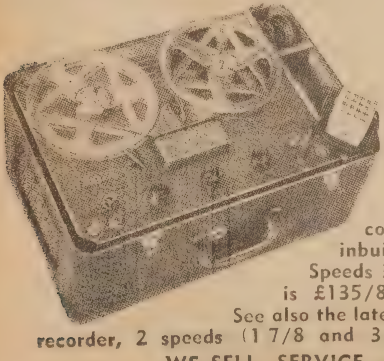

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I must confess the whole thing was rather bewildering. I tried the plug in and out myself a couple of times with the same result, then tried switching the heater off but leaving the plug in the socket. This had no effect, suggesting that at least the active lead was not involved.

This gave me an idea and I pulled the plug out again and party replaced it at such an angle that only the earth pin was making contact. As I did so the volume dropped, rising again when I opened the earth circuit. Then I checked the receiver plug and noted that the set was earthed via the third pin. Both these facts fitted in with the idea that was forming in my mind.

"Unless I am much mistaken," I said to my friend, "we may be chasing a false lead as far as this sink heater is concerned. I don't think it really has any bearing on the fault in the set." Then I went on to explain why I thought this was so.

SEPARATE EFFECTS

As I saw it the two effects—the drop caused by the fridge or other device (which was not a reversible effect), and the gain caused by unplugging the sink heater (which was reversible) —were quite separate, the fact that one appeared to exactly offset the other being pure chance.

Once this point was clearly established it remained to explain why the sink heater had any effect at all on the set. The fact that it was a sink heater gave me the clue to that one. Only a water heater would be likely to provide a more direct earth than that available in the house wiring system, due to its intimate connection to the water mains.

A quick check on the house wiring layout tended to support this idea. The actual earth point was several rooms away at the front of the house, meaning that the earth wire could be picking up a lot of RF energy. Also, I did not overlook the possibility that the earth connection might be faulty, but a check showed it to be perfectly OK.

In addition, the earth wire became airborne at the rear of the house where it ran to a combined workshop and laundry. All in all, I considered that the earthing system could be picking up quite a lot of signal, apparently enough to make good the loss due to the fault in the set.

SHORT EARTH

But when the sink heater was plugged in, it connected the earthing system to the water pipe only a few feet away. Furthermore, the water pipe went directly to the ground at this point, so that this action effectively "killed" the extra RF being picked up on the earthing system.

If this theory was correct the act of unplugging the sink heater would still improve the set's performance even when the fault was not in evidence. However, I suspect that this had never been tried simply because it had never been necessary.

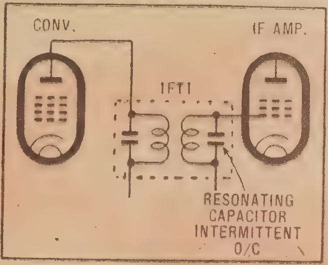
Of course, all this was largely speculation, yet I felt that it was a reasonable assumption. At least we could avoid being sidetracked by what might be a "red herring."

And so we turned our attention to the set itself. At my suggestion — and since we apparently had the kitchen to ourselves — we decided to tackle the job right on the spot. This was a precaution against possible altered conditions in the workshop, which might cloud the issue.

The set had been playing while we checked earth wires etc., and was still in its weakened condition. This was a highly desirable state of affairs and I expressed the hope that it would stay that way. If it did we could forget the "intermittent" bogy.

We started with a voltage check, but this revealed nothing likely to cause the bother. I wasn't really surprised; intermittents seldom show up as easily as that.

Next I tackled the various by-pass capacitors. In cases like this the most likely culprits are those in the AVC circuit and the main HT by-pass (when one of these latter is fitted at all!). Screen by-passes can give trouble, of course, but generally produce instability and are therefore easier to trace.



Failure of the set itself was relatively simple—when we found it. The resonating capacitor in the 1st IF was intermittent O/C.

My friend produced a .5 from a box of spare parts and we went over the set, shunting each by-pass with it in turn. The result was completely negative. The only good thing was that the set was still maintaining its faulty condition in the face of all the electrical shocks it received.

At this stage I would have given a lot to have a generator handy, in order to establish just which stage was "sick". I had checked the audio section in the time honored fashion and, as far as I could tell, it was performing normally for a single stage.

This left the IF and converter stages, including two valves, two IF transformers, the aerial and oscillator coils, and a number of minor components. Anyone of these could be faulty in a fashion which would be hard to find by the traditional "screwdriver and bash" technique.

VALVE PROBLEM

There wasn't a great deal I could do about the valves. If they had to be tested I would have to take them back to the shop after the holidays. In the meantime I could only assume they were OK and check as many other angles as possible.

An alignment check seemed the next most logical check, even if it was only a rough one. The second IF peaked OK and was within a whisker of optimum setting but, at the first IF, I "struck oil". One of the slugs just wouldn't peak; in fact, it seemed to have very little effect on the performance at all, even when varied over the entire range.

"This could be the culprit," I said to my friend. "What do we do; try to fix it or have you a spare we could try?"

My friend thought he had a spare—"somewhere"—and we retired to the workshop and commenced a search of the junk box. When we eventually unearthed it it turned out to be a "2nd" type rather than a "1st", but I reasoned it would still be better than the one in the set.

However, when we removed the can to fit a grid lead, a sorry sight met our gaze. This IF had obviously also given trouble at some time in the past, for it had all the appearance of having been taken to pieces and put together again. My friend recalled then that it was one he had unsuccessfully tried to repair some years previously.

So it looked like trying to fix the IF after all. The only question was, why had it failed?

RESONATING CAPACITOR?

Considering all the symptoms I risked a shrewd guess that the resonating capacitor would be the most likely culprit; most probably being intermittent open circuit.

So we removed the can with the idea of replacing this component. Then I realised why the spare unit we had just discarded had looked so knocked about. The whole of the "innards" were most effectively sealed in in a brittle black bitumous "goo" which looked far from inviting. The resonating capacitors were not even visible. Presumably they were buried under the goo in a cup-like formation which was part of the moulded base.

However, there seemed to be little to lose so, having identified the appropriate winding and associated leads we attacked the goo with the tip of the soldering iron and the point of a fine screwdriver.

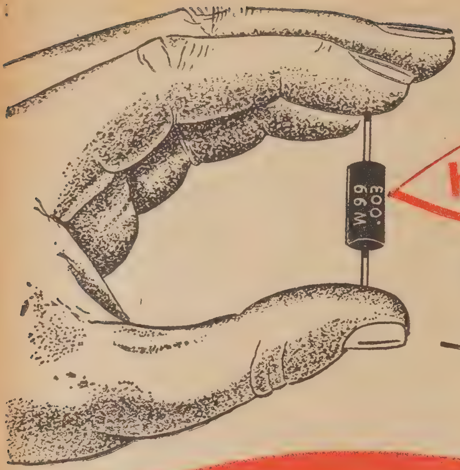
Eventually we struck something hard then, after more digging, the capacitor was revealed. At this stage I switched the set on again and prodded the suspect capacitor with the insulated end of an alignment tool while it played. The set spluttered and crackled in a most gratifying way; there seemed little doubt now that we were on the right track.

AWKWARD JOB

It wasn't easy to unsolder the condenser from between the base pins but we eventually managed it. And we weren't very impressed with its appearance when we did. Just a couple of strips of mica and metal foil riveted together in rather crude fashion. There was no protective moulded casing; just the bare essentials immersed in the black goo.

It also presented us with a couple of other minor problems. One was the value of the device, for it had no markings on it, and the other was how to accommodate a replacement, for there certainly wasn't room for a conventional one in the space left by the faulty one.

I solved the first problem by taking a chance on 100 pf—the usual value—and the second by mounting it between the base pins under the chassis. When all was re-assembled I switched on and tackled the slug again. It peaked up beautifully and the gain of the set came good in no uncertain manner. After checking the remainder of the alignment I ventured to prophesy that the set should now perform satisfactorily.



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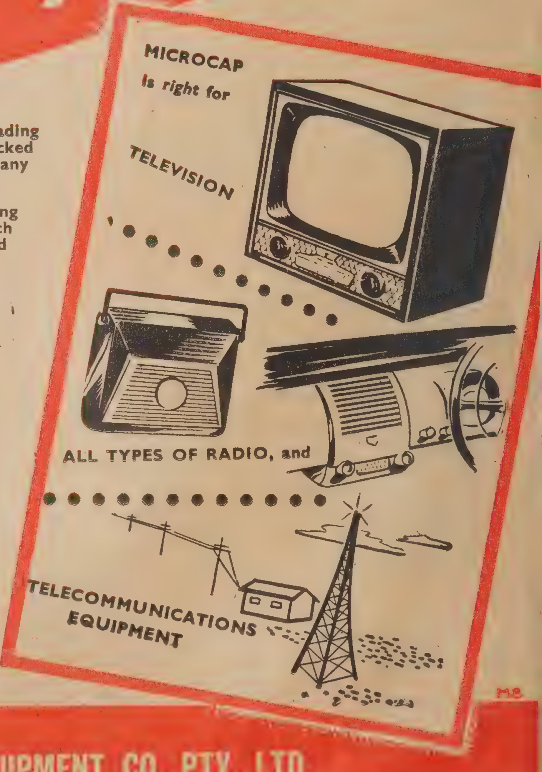

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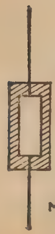

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After tuning across the band my friend agreed, and we fitted it back in the cabinet. Then, to satisfy my own curiosity, I tried the effect of the sink heater connection once again. As I had expected, it still varied the volume in the set, though to a lesser extent. I imagine this was due to the AVC having some control now that the set had normal gain.

However, a point I did notice was that the improvement was most marked at the low frequency end of the band. In fact, now that I came to check it more carefully, I realised that the overall performance was poor at the low frequency end. Admittedly, it was good enough, but just didn't have the same order of performance as it did at the middle and high frequency end.

AERIAL COIL?

Perhaps it was trying my luck a bit far, but I ventured the opinion that this could be due to the design of the aerial coil, since I had noticed that it was a fairly old type. Modern aerial coils are designed so that the primary winding is self resonant somewhere just below the broadcast band when connected to a typical aerial. This is intended to offset the reduced gain, which naturally occurs at the lower frequencies.

In this case the performance seemed to peak somewhere near the middle of the band at the expense of the low frequency end.

While a longer aerial would probably have helped, I suggested to my friend that it might be worth while to try a more modern aerial coil; one that would resonate somewhere near the end of the band, with a moderate size aerial. He agreed with this suggestion and added that he thought he had one tucked away somewhere and which he would try at the first opportunity.

In the meantime we both considered we had had enough trouble-shooting for one afternoon. We made for the lounge, where the womenfolk were already entrenched. Our entrance brought forth a typical female comment. "Well!" (pause for effect). "—and where have you two been loafing the last couple of hours?"

My friend and I exchanged glances. I shook my head slowly; he shrugged his shoulders. What was the use?

THE LESSON

Seriously though, when I look back, on the incident, I feel the lesson to be learned concerns the effect of electrical appliances on receiver performance.

Whenever one hears about appliances which affect receiver volume, the natural inclination is to assume it is an intermittent in the set. While this can be so, it is not necessarily the case. Careful observation of the phenomena, or careful questioning of the owner, will often prevent the serviceman going off on a false trail.

There are two general causes of this effect. One is the true intermittent—of which the case just describd is as typical an example as one could wish—and the other generally involves interaction between the house wiring and the aerial and earth.

I need hardly point out how important it is to differentiate between them. There is little point in completely overhauling a set—and charging the customer a substantial fee—when the trouble is not in the set at all. Many a customer has expressed dissatisfaction with a repair for just this reason—and then taken his business elsewhere.

In the case of a true intermittent the effect of switching on an appliance is to produce a "shock" signal which may either initiate or cure the fault. Normally the first such shock to occur whenever temperature and other conditions are just right will do the trick. The exact source is not important.

I call these effects "non-reversible", because, while switching an appliance on may cause one effect, switching it off seldom produces the opposite result.

The other effect is due, in part, to the aerial or earth system, or both, picking up RF energy by one means or another from the mains. In these cases the switching on of a light or the plugging in of an appliance can alter the field strength pattern sufficiently to change the volume.

I call these effects "reversible" because switching the light off again, or unplugging the appliance, will usually have the reverse effect and restore the volume.

And that is generally the easiest way to distinguish between them. If the effect is consistently "non-reversible", look for an intermittent in the set. If it is "reversible", check the aerial and earth system carefully and consider what can be done to make them independent of the mains influence.

PARTY HIGH JINKS

Another brief incident I have to relate also occurred during the holiday period, on New Year's Eve to be exact. Mrs. Serviceman and I were enjoying the hospitality of a near neighbor, waiting for the Old Year to kick its last, and my thoughts were far removed from service stories.

In fact, my only idea regarding radio concerned the form of torture I would most like to inflict on the cry-singer whose mournful wails were being inflicted on my sensitive ears at that moment.

Then it happened. The radio gave a couple of crackles, the cry-singer faded to a whisper, and his voice commenced to gurgle as though he was drowning in his own tears. The lady of the house then came forth with what must rank as a classic statement.

"It's that television station again, upsetting the radio."

I'm afraid I did a double take on that one, and nearly choked on my dry ginger ale.

"Why blame the television station?" I inquired. (The location must be a good 10 miles, as the crow flies, from the transmitter.)

"Oh, it's the television all right," she replied, "the man next door has the same trouble." I shook my head. We seemed to be getting nowhere.

"But why blame the television?" I persisted.

"Well," she replied, with the air of one settling down for a long explanation of a difficult subject, "several weeks ago, when one of the television stations opened, the man on the wireless said that the new station would commence transmitting in 10 minutes' time. And in 10 minutes' time the set went dead. So it must be the television." (I nearly added, Q.E.D.!)

(Continued on page 105)

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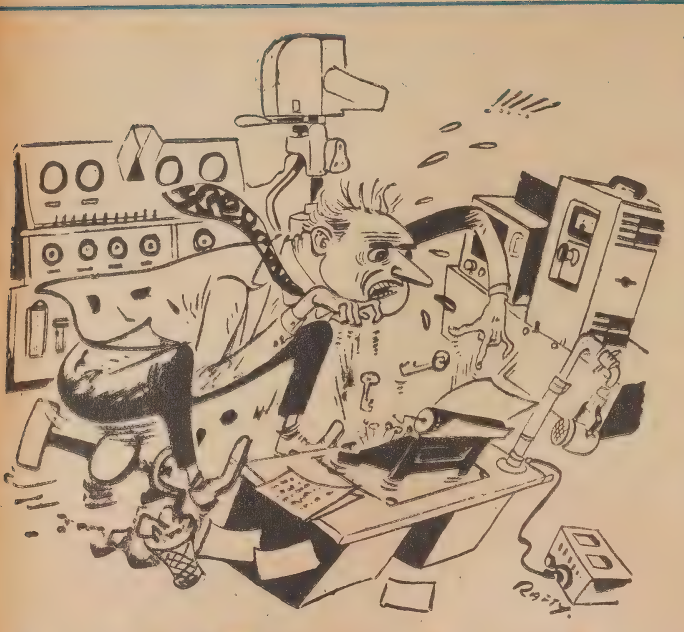


Lets Buy An Argument

About this time of the year, with holidays in the offing, it seems appropriate to collect together and dispose of several argumentative oddments, which have accumulated over the past few months. There is, for example, the contentious matter of 21-inch versus 17-inch television screens.

by Neville Williams

THIS has been a "hot" one on a trade basis for quite some time and we've had our own private arguments in the office—or at least over the lunch table.

Perhaps it would be more genteel to refer to them as "animated discussions".

Our worthy confrere, Philip Watson, isn't at all convinced by arguments in favor of the 21in tube and is quite happy to be quoted on the point.

EARLY HISTORY!

Phil is one of these fellows who was born, apparently, with a camera in one hand, an exposure meter in the other and a developing tank gripped firmly between his (then) toothless gums. His attitude is that of a typical photographer.

He maintains that a 17in screen is large enough to be viewed conveniently in an ordinary living room; that it is capable of resolving and presenting all the detail that can possibly be contained in a 625-line television system.

To present the same picture information on a large screen is tantamount to enlarging excessively a poor negative—it merely emphasises the grain and other shortcomings of the said negative.

By the same reasoning, if an over-large television image is viewed close up, it loses value by reason of a too-obvious line structure, etc.

If the viewing distance is increased, until these undesirable effects become less obvious, then the angle subtended at the eye is much the same as that of a smaller image viewed close up.

So goes the argument.

Mr. Watson agrees that line structure and other imperfections of the picture are masked to some extent by movement and interest in the picture. If you have any doubts on this score, just get hold of a snipping from a 35mm movie and see how large a "still" you can make from it.

Even allowing for this, however, he feels that it is hard to make a case for the larger screens. That, if people prefer them, it's without justification and only in an effort to obtain some quality that they can't get anyway.

WHY OH WHY?

Against all this is the undoubted fact that people seem to congregate around large screens rather than smaller ones. Perhaps they shouldn't; perhaps they haven't been told not to; but they do.

My own thoughts on the matter stem not from television at all but from the currently popular pastime of viewing 35 mm color transparencies.

I had seen many of these on little screens from one to three feet wide. Then a large projector came my way and a screen big enough to take up to 8ft pictures. The difference in "impact" was terrific.

As one enthusiast put it . . . "The pictures come to life. Streets look as if you can walk right out into them."

That order of enlargement may not be necessary to see all the potential detail in a double 35mm frame but, to my mind, the impact is undeniable.

Why?

My own feeling is simply this—the larger the picture, the less its content is dwarfed by its surroundings. A street scene can never be fully convincing when its dimensions and surroundings and proximity all tell you that it's no bigger than Grandpa's armchair, standing nearby.

I think, personally, that something like that operates in the case of television. People like the larger pictures intuitively, because they get that much closer to real life; because they are less dwarfed by surroundings in the room.

People without a photographic background don't stop to reason whether they can see more detail or not. They don't argue about bandwidth, resolution or spot diameter. They react to the general impact of the picture and like it or dislike it accordingly.

But why stop at 21in? Wouldn't the argument apply progressively to 24in or 27in or even larger screens?

Of course it would but, sooner or later, the basic limitations of the image must impact themselves upon even the least discriminating viewer. Sooner or later the picture must begin to break up into rows of crawling lines, particularly if the viewer's eyes play tricks with the interlacing.

When that happens . . . "he doesn't like that picture, and it's too dear anyway."

But, without those limitations, I think he would. I think he would go on liking bigger pictures till, if it were possible, they filled half a wall.

CRYSTAL SETS

On another subject, I have noticed several letters lately, in the mail, asking for an explanation of short-wave reception on crystal sets.

By and large, past experience has been that crystal sets have not been a proposition on short waves. This has possibly had something to do with the frequency characteristics of typical detectors as well as the limited field strength of short-wave transmitters.

Of late, however, I have seen several references to readers having heard short-wave programs through ordinary crystal sets — mostly "Radio Australia" but powerful overseas stations in one or two cases.

Significantly, the sets concerned have generally been rather primitive devices, using slide tuning or tapped coils in place of the regular tuning capacitor.

The Q-factor of such tuning circuits is quite low and they can readily have resonance effects superimposed on them from aerial and earth circuits. Thus, while a receiver may ostensibly be designed for broadcast band operation, it may well have an accidental response on the higher frequencies.

And this, I feel, is the immediate explanation for the unexpected appearance of short-wave signals in the earphones.

However, the interesting point is not so much how the signals have been heard but the fact that they were heard at all. It indicates the order of signal strength which some short-wave transmitters are now able to lay down.

And if the stations can be heard more or less accidentally, what kind of reception might now be expected from crystal receivers expressly designed for short-wave work?

Maybe an interesting new kind of DX has arrived.

Or am I behind the times? There may perchance be readers who have been crystal-short-waving for years.

I'd like to know.

IDEAL FOR SCOTS?

While on the subject of crystal sets, I have noticed a couple of references recently in overseas literature, to self-powered transistor sets. While not exactly a "crystal set", such receivers have this in common that they derive all the power required for their operation from incoming signals.

They do not need batteries or any connection to the power mains.

The first such reference was in "Radio-Electronics" for April, 1955, in a short article by W. H. Grace jun. The writer said that he had been using a self-powered receiver for some time with a good deal of success.

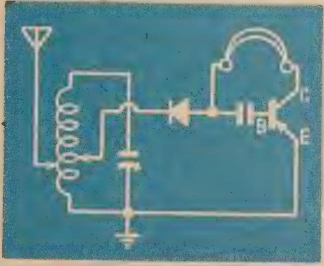
The basic idea is evident from the accompanying circuit.

The tuning coil, capacitor and crystal couple together as for a normal crystal set, specifications and tuning adjustments being exactly the same.

Output from the detector diode will be, as usual, a DC component, varying in sympathy with the modulation.

In an ordinary crystal set, this is simply passed through the phones to earth, the DC component in itself serving no useful purpose.

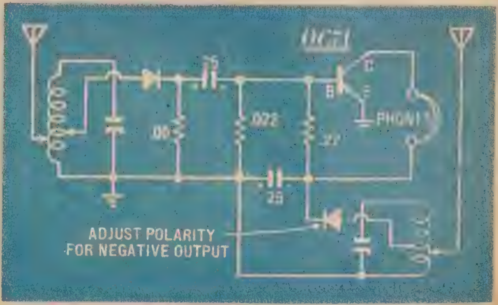
In the circuit suggested, the DC component is applied through the phones to the collector of a transistor. The emitter is earthed and an audio signal is fed through a capacitor to the Base.



A circuit for a simple self-powered transistor receiver, along lines suggested some months ago in "Radio-Electronics".

The writer points out that the detector must be connected the right way round to supply either a positive or a negative Collector voltage, whichever is required by the transistor.

He says that, if a crystal set can produce an output current, measured across the phones, of about 100 microamps, worthwhile amplification will be obtained from a transistor connected as shown.



A circuit along these lines might have interesting possibilities. The crystal receiver on the right produces power from a strong local broadcast station. It powers the transistor which amplifies signals from weaker stations tuned by the set on the left.

If the signals are such as to produce a 500-microamp current, then considerable amplification is possible with the transistor.

I must confess that I wasn't greatly impressed by the idea, when I first noticed it, perhaps because of a natural suspicion of anything that purports to give you something for nothing.

But even assuming the idea did work, it was rather back-to-front in applying maximum amplification to the signals which least needed it. And finally, because of the lack of decoupling, the ultimate signal current affecting the phones would be a rather obscure combination of the direct output from the detector and the "amplified" output from the transistor.

The writer suggested that power from the transistor might actually be derived from another station altogether, making the amplification effective for weak signals.

Frankly, I wasn't much impressed by this idea either, because it seemed so much easier and simpler to buy a couple of cells — or use the run-down ones from the family torch.

But perhaps such an attitude is being a little too practical and prosaic, forgetting the fact that plenty of people get quite a kick out of doing things the hard way.

What possible explanation could there be, otherwise, for the practice of spending a fortune in time and money over an old bomb, so it can qualify as a "vintage" car?

NEW KIND OF DX

Similarly, if one can gain technical satisfaction by devising a self-powered transistor set, why should they be denied the pleasure.

There might therefore be looming the basis for yet another form of DX — the reception of stations on any band, using any number of transistors but powered only by the energy picked up by radio circuits.

In a recent editorial on Nikola Tesla, Wireless World pointed out his perhaps unfortunate preoccupation with the "shadow of power transmission" rather than the "substance of radio communication".

It went on to say, however, that the power requirements of a modern transistor, as compared with those of a valve, may change drastically our concept of what is or is not a worthwhile amount of power to intercept by "wireless",

Reference was made to an article by Dr. H. E. Hollman in Electronic Industries for September, 1956. It was entitled "Free Power Receivers."

Dr. Hollmann's scheme is apparently to tune, rectify and filter the signal from some powerful, nearby broadcast station. This would then be used to energise transistors, to receive and amplify the signals from weaker, more distant stations.

Where this was not practical, Dr.

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Hollmann claims, apparently, that the desired station's own carrier could provide enough power to give a useful degree of amplification—exactly as per the statement from Radio-Electronics mentioned earlier.

Dr. Hollmann's explanation of the phenomenon is simply that the scheme utilises the full carrier power of the incoming signal, whereas a simple crystal set utilises only the energy contained in its modulation.

It is not a question at all of getting something for nothing but rather of using energy in the signal which is normally wasted.

WORTHWHILE?

The point at issue, I should imagine, is whether the energy difference is likely to be apparent or whether it will not be offset completely by the efficiency (or inefficiency) of even a transistor amplifier.

But the idea of filching some carrier energy from a strong local to amplify a more distant station is intriguing and should, I imagine, spur some of our small-set fans to activity. I'd be in it myself but for the present preoccupation with television and its allied problems.

I can imagine that there is a nice legal point here for those readers who may prefer regulations to resistors: who owns the radiated energy that is present within the boundaries of your property? Can you use it (legally) for any purpose you desire? Is the energy from national stations in a different category from that of the commercial broadcasters?

I mention this to intrigue rather than deter you. I can't imagine anyone being the slightest bit upset by experiments with "free-power" receivers.

Therefore, if you want somewhere to start, I suggest a circuit which is virtually a combination of two crystal sets and the "Matchbox" transistor amplifier described in our March, 1956, issue.

The idea would be to make the basic receiver work with a 1½-volt cell as originally intended The second receiver, to provide the power, would then be tuned to the strongest available local station Selectivity wouldn't matter—just the strongest signal you could hear.

"HT" SUPPLY

Check the polarity of the output current with a meter, then connect it across the "high tension" filter capacitor in place of the cell.

But why use two aerials?

Not essential, but simply as an initial precaution against interaction.

But this isn't a constructional article. It's simply an idea that might prove interesting.

On the other hand, it mightn't even work.

But who knows? One of these days unattended transmitters may send back weather and other information anytime an accompanying "receiver" is powered by a carrier on a particular frequency.

Now for another violent change in subject matter.

After G.T.'s letter in the last issue re the post-synchronising pulses in a TV signal, I waited with bated breath for the promised explanation.

Well, here it is, set out in the accompanying panel.

THE POST-SYNCH-PULSE MYSTERY

Dear Sir,

Thank you for acknowledging my letter regarding the post equalising pulses in the TV synchronising waveform.

It took me many hours of enquiry to find out what is the need for these but the explanation is as follows:

For a receiver using a blocking oscillator for the vertical timebase, they are not required at all. Perfect interlacing will result with only the pre-equalising pulses. But in receivers using the more popular cathode-coupled multivibrator, they are essential.

The cathode-coupled multivibrator can and does synchronise with either tube conducting, so that on the field pulse commencing at the half-line position the "pre" equalising pulses will result in correct triggering to give interlace.

After the broad pulses finish, if there are no post-equalising pulses, while the integrating circuit is discharging, the next convenient line pulses will cause triggering of the other side of the circuit and will cancel out the half-line difference which has already been achieved.

This will result in sequential scanning, not just pairing.

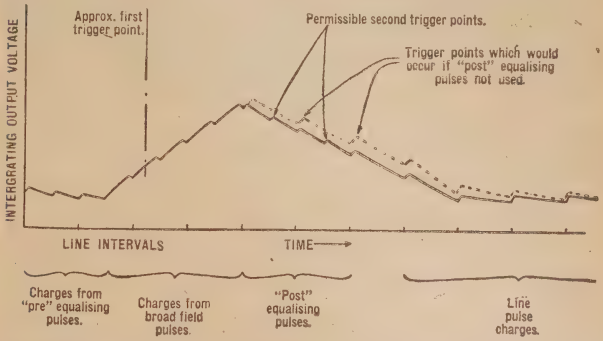
But if the post equalising pulses at half-line intervals are included in the synchronising waveform, the circuit will trigger on one of these. Which one it is depends on the time-constants of the particular receiver, thus maintaining the half-line displacement for this field.

On fields commencing at a full line they are not really necessary, as the second trigger has to occur at the line interval.

You will notice that I do not use the term odd and even fields, which is another cause for argument. Some say that the booklet Standards For Australian Television Service is wrong. So which is the odd and which is the even field?

The question of the need for equalising pulses has been in a previous exam paper for the TV Operator's Certificate exam.

Yours Faithfully, G.T.



After reading it several times. I'm still just about as wise as ever. I'm still not sure whether G.T. is on a completely wrong track or whether he has so condensed his explanation that its meaning has been sadly prejudiced

G.T.'s idea appears to be that the frame oscillator can receive a double synchronising pulse, one from the front the other from the rear of the integrated waveform. Whether this is a necessity, a characteristic or a possible accident is not clear from his letter.

The normal concept is that any type of oscillator receives a pulse from its synch. source as it approaches the end of each forward trace. The pulse initiates the flyback, leaving the oscillator to complete the flyback and commence the next forward trace, according to its own natural characteristic.

In the case of the frame oscillator, triggering occurs somewhere along the front slope of the integrated waveform. By keeping the front uniform, by means of pre-equalising pulses, amplifying the slope in the receiver and taking various other precautions, triggering is maintained ideally at a uniform point on the slope.

Then, as the position of the slope (dependent on the wide synch. pulses) is varied in relation to the line pulses, a half-line relationship is established which gives the desired interlacing.

POSSIBLE IDEA

Now G.T.'s implication is apparently that a cathode-coupled multivibrator derives a synch, pulse from the rear integrated slope. Presumably this would initiate the forward trace, so that both flyback and forward trace are under control.

This being the case, it is just as important to control the rear slope as it is the front slope of the integrated waveform. Hence the post-equalising pulses.

But is it the case?

Is a multivibrator designed to have such a short recovery time that it would be open to receive a second pulse so close to the first?

(Continued on Page 83)

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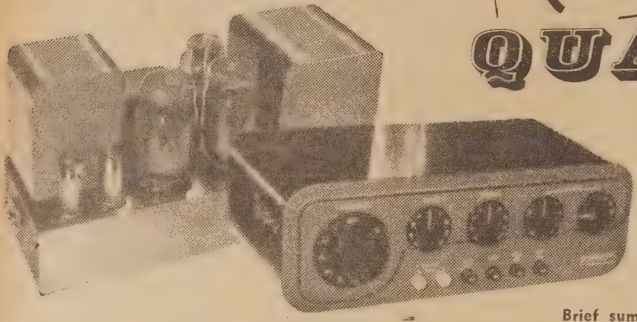

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A SIMPLE COURSE IN RADIO — 2

ALL ABOUT BATTERIES

Primary cells, their chemistry, construction and life—series and parallel connection—layer-built batteries—secondary batteries (accumulators)—the hydrometer.

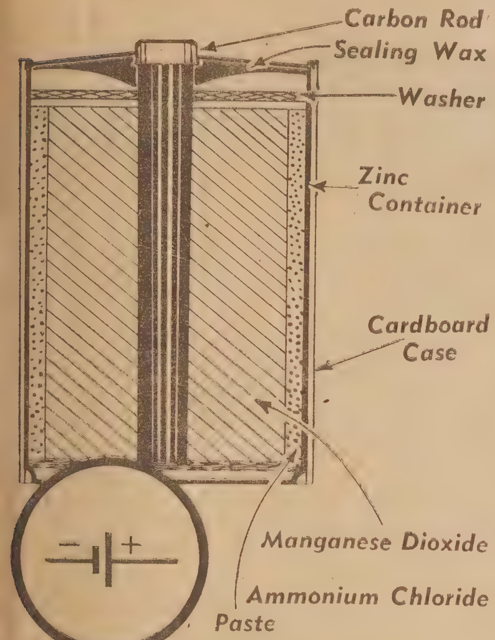

Figure 1. The construction of a typical primary cell of the "dry" cylindrical type, as used for torches, radio batteries, etc. This type of cell has been in vogue in this general form since the earliest days of electricity.

Mention was made last month of the electric battery and its ability to promote the flow of current through a conductor. In this issue we tell you something about batteries — how they work and how they can be used in electric circuits.

A BATTERY may be defined as a device which, by chemical action, produces a surfeit of free electrons at one terminal and a large number of positive ions at the other. The first terminal is negative; the second is said to have a positive charge, because it is deficient in free electrons.

When the two terminals are joined by an external conducting path, the electron pressure or EMF of the battery causes a movement of electrons along this path. In other words, the battery initiates the flow of an electric current through the external conductor.

CELLS AND BATTERIES

To be precise, a single electrochemical unit should be referred to as a CELL; an inter-connected group of cells makes up a battery.

Investigators have produced quite a variety of electric cells, and a lot of space could be devoted to a discussion of their chemical action and their characteristics. However, for the purpose of this article, it seems more appropriate to devote the necessary mental energy to a study of the two types normally used with radio apparatus.

The first crude cell was made in 1789, sufficient to establish the electro-chemical principle.

The first really practical cell was produced by Georges Le Clanche in 1868. Le Clanche cells utilised a carbon rod for the positive electrode and a piece of zinc for the negative pole; the carbon is surrounded in a porous container by powdered manganese dioxide and the whole lot located in a glass jar containing a solution of sal-ammoniac (ammonium chloride).

The Le Clanche cell in this form, though an entirely practical arrangement, suffers from the disadvantage of having a liquid electrolyte, subject to spilling and "creeping".

The problem was largely overcome when, in 1888, a "dry" cell was produced by Dr. Gassner, utilising the basic Le Clanche principle but in a more convenient form.

The modern "dry" cell is essentially similar to that produced by Gassner. The glass jar is eliminated and the negative zinc electrode becomes the container for the chemicals. The positive carbon electrode is retained, and the manganese dioxide, but the sal-ammoniac is thickened to a non-spillable paste. A coat of wax over the top serves to seal the whole unit.

Such a cell is not truly dry and, indeed, could not be so. However, the cell may be used in any position without danger of the electrolyte spilling or doing damage to other apparatus. Although dry cells have changed little in appearance for many years, various chemical refinements have trebled and even quadrupled their service life.

When first manufactured, the cell builds up a certain electromotive force (EMF) across its terminals and, thereafter, the chemical action becomes very slight. However, there is always a slow chemical action going on and a drying out process, so that a cell will not remain fresh indefinitely.

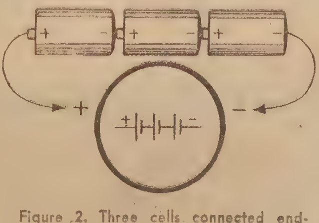

Figure 2. Three cells connected end-to-end to produce an E.M.F. of 4.5 volts.

After a few months, its terminal voltage begins to diminish and the amount of electrical energy it can supply becomes very limited.

The ability of a cell to remain "fresh" for a long period of idleness after manufacture is expressed in terms of its SHELF LIFE. Generally speaking, large cells have a much longer shelf life than small ones.

When, in actual service, a conducting path is provided between the terminals, there is an evident electron movement from negative to positive, which tends to relieve the electron pressure within the cell. However, the cell automatically tries to maintain the initial EMF between its terminals, so that the flow of electric current is invariably accompanied by increased chemical activity.

CONDUCTING PATH

The zinc of the container combines with the ammonium chloride to produce hydrogen and a basic chloride compound containing both zinc and ammonia. This latter compound is responsible for the whitish crystals which are often in evidence in and around a run-down cell.

The hydrogen makes its way toward the carbon rod, tending to surround

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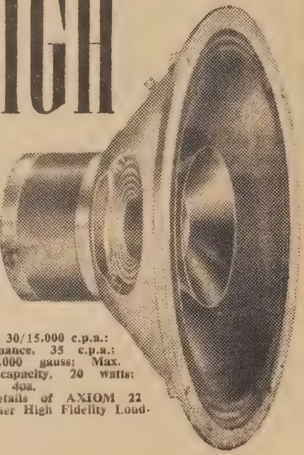

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it with a film of hydrogen. The gaseous layer could ultimately interrupt the chemical action but this so-called POLARISATION of the cell is prevented by the manganese dioxide which has already been mentioned as surrounding the carbon. The manganese dioxide oxidises the hydrogen to form water and manganic oxide.

An accepted explanation of the electro-chemical action is that the zinc is deprived of zinc ions (not atoms) so that the zinc is left with an accumulation of free electrons. Further, that hydrogen ions move toward the carbon rod, so that it exhibits a positive charge and the zinc a negative charge.

VOLTAGE OF 1.5

All dry cells of this description have an initial EMF or 1.5 volts or thereabouts between their terminals, irrespective of their physical size. However, large cells have a much longer shelf life than small cells, and, in service, can supply much heavier currents without running down.

Because of this, it is always sound economy to use the largest feasible dry cell for any application, even though its initial cost is higher. Smaller, cheaper cells, handy though they may be, are usually less economical in the long run.

The larger a cell, the greater is the surface area over which chemical activity can be evident. Therefore, such a cell is better able to maintain its electron pressure—or EMF—when called upon to deliver relatively high current.

The loss of EMF due to output current may be regarded very conveniently as an apparent INTERNAL RESISTANCE of the cell itself. This internal resistance is small with large cells, and increases as the size of the cell is diminished.

THE SIZE OF CELLS

The largest dry cell in common usage measures about 6in in height and 2in in diameter, and has a shelf life of at least a year—generally much longer. It is designed for a normal intermittent load of between 200 and 300 milliamps and is frequently used in telephone circuits.

The cells used in the largest radio batteries will handle normal loads up to only 15 milliamps but give a useful life, on intermittent service, of 500 to 700 hours.

The smallest cells will comfortably deliver only 8 to 10 milliamps and give only a small fraction of the service life.

A sectional drawing of a typical dry cell is shown in figure 1, together with another of the schematic symbols dear to the hearts of radio and electrical engineers.

CIRCUIT SYMBOL

As you can see, a single cell is represented by two parallel strokes of unequal length, occurring in a solid line. As a rule, the longer stroke signifies the positive side of the cell, but it is occasionally found the other way round.

To be on the safe side, most circuit draughtsmen clearly mark the polarity with a plus and a minus sign, as shown.

For many purposes, the E.M.F. or voltage available from a single dry cell is often inadequate and a higher voltage is obtained by connecting two or more cells in SERIES. That is to say, they are linked together with the positive terminal of one cell going to the negative terminal of the next, and so on.

Any number of cells may be connected in this way, and the two terminals left over are the positive and negative connections to the bank of cells—or the battery, as it is generally called.

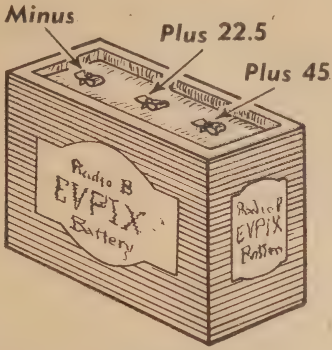


Figure 4. A typical radio "B" battery, delivering an E.M.F. of 45 volts and having a tapping at 22.5 volts.

The most familiar illustration of this principle is that afforded by the ordinary two or three-cell torch.

In ordinary flashlight cells, the tip of the positive carbon rod protrudes through the wax and is fitted with a brass contact cap. The negative connection is actually the bottom of the zinc can.

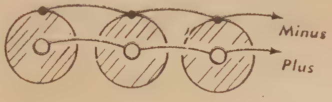


Figure 5. By connecting cells in parallel, the terminal voltage is unaltered but the current handling capacity is multiplied.

When the cells are pushed into the torch case, they are automatically connected in series and the resultant E.M.F. is equal to the sum of their individual voltages. For two cells it is approximately 3.0 volts, for three cells about 4.5 volts and so on.

The connection is illustrated graphically and schematically in figure 2.

For the sake of convenience, battery manufacturers often assemble a number of cells in a single package or carton, connecting the cells together internally and bringing out just the one negative and the one positive lead. The actual voltage depends mainly on the number of cells contained.

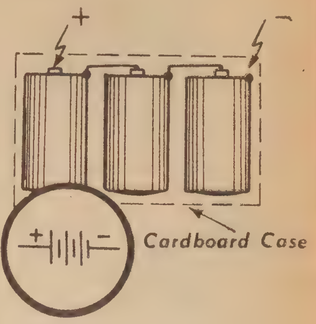


Figure 3. Three cells, wired in series and packed in a single cardboard carton to provide a convenient 4.5 volt battery.

In figure 3, three cells are shown connected in this way, with the appropriate schematic symbol beneath.

The traditional radio B-battery, as indicated in figure 4, contains a total of 30 cells, delivering an E.M.F. of 45 volts between the negative and positive terminals. Batteries delivering even higher voltages are quite common nowadays, many being fitted with socket connections instead of clips, as shown.

The method of representing such batteries schematically is worth noting. There is an obvious objection to drawing 30 or more individual cells, so that circuit draughtsmen normally show a couple of cells at each end, with a dashed line between them and a figure signifying the voltage of the battery, or even of a group of batteries.

For certain applications, voltages may be required intermediate between the negative and the full positive E.M.F. Standard procedure, in this case, is to provide the battery with one or more intermediate terminals, connected to the appropriate point in the series network of cells.

HIGH TENSION BATTERIES

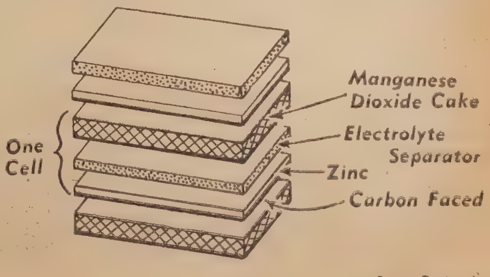
In the radio B-battery, as illustrated, a lead is brought out from a point halfway along the series network of cells, giving a voltage 22.5 volts positive with respect to the negative terminal.

Some special-purpose radio batteries have intermediate tappings brought out

★

Figure 6. In the layer-built dry cell, the chemicals are stacked one up on the other in sandwich fashion. Interconnecting wires are eliminated and considerable space saved.

★



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from each cell in the network, or from each second or third cell.

It is well to note in passing that two or more cells may alternatively be connected in PARALLEL, the positive and negative terminals being joined together as shown in figure 5.

With this arrangement, the E.M.F. between terminals remains at 1.5 volts (approx.) but the load current is shared between the total number of cells.

Because each cell is then called to deliver only one half, one third, one quarter etc. of the total load, the bank of cells can handle a proportionately higher current than any one of the cells singly.

A similar current capacity, with possibly longer shelf life, could be obtained from a single very large cell, but the parallel arrangement is sometimes used for convenience or expedience.

LAYER BUILT TYPE

The latest development in dry batteries is the LAYER BUILT type, which is put together in the form of a sandwich. First there is a sheet of zinc, then a layer of ammonium chloride mixture; then manganese dioxide and finally the carbon strip.

Resting on the carbon is another layer of zinc belonging to the next cell in the pile.

An ingenious system of assembly prevents leakage of electrolyte from one cell to the next.

The direct contact between cells eliminates interconnecting wires and there is none of the waste space occasioned by the former practice of assembling round cells in rectangular cardboard separators. Chemically, however, the cells are identical.

In cells of the Le Clanche type, the electro-chemical action necessarily ceases when the chemicals have been used up and the cell is then of no further use.

These so-called PRIMARY CELLS are distinguished from SECONDARY CELLS by the fact that the latter can be made to deliver current afresh by a process called RECHARGING.

The most common type of secondary cell or battery is the lead-acid accumulator used in motor vehicles and as "A" batteries in old-style battery radio sets.

LEAD-ACID ACCUMULATOR

In the lead-acid accumulator, two sets of lead plates are immersed in dilute sulphuric acid and connected to an external E.M.F. in such a way that a current of up to several amperes flows through the acid via the plates.

The flow of current causes the acidulated water to be decomposed, releasing atoms of hydrogen and of oxygen at the respective plates. The hydrogen mostly escapes, but the oxygen liberated at the positive plate combines with the plate to form the dark brown peroxide of lead.

When the charging has proceeded for an adequate length of time, the battery may be removed from the charging circuit.

If a conductor is then connected between the two plates, a current is found to flow, and, as it does so, a chemical change becomes evident in both plates. The positive plate, coated with lead peroxide begins to take a coating of greyish lead sulphate, and much the same thing happens to the lead negative plate.

The "sulphate" molecule comes from the acid, which is therefore progressively weakened as the discharge continues.

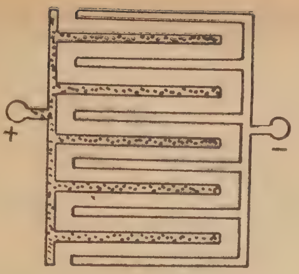

Figure 7. In the secondary battery, or accumulator, each cell contains a group of interconnected plates, arranged in grid fashion.

When next the cell is charged, the lead sulphate on the negative plate is reduced to pure spongy lead, and the coating on the positive plate reverts to the dark coloured lead peroxide. At the same time, the strength of the acid is built up again, so that the cell is ready once more for a period of discharge.

This charge and discharge cycle can be repeated hundreds of times until, after a period of perhaps several years, the active electrodes begin to disintegrate.

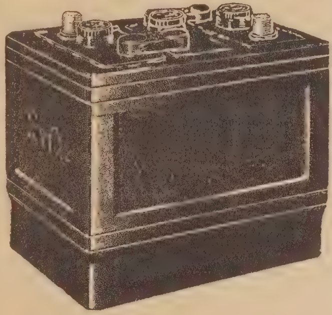

Figure 9. A typical 6.0 volt accumulator, as used for automobiles or large radio receivers.

The chemistry and construction of a lead-acid accumulator is rather more complicated than the foregoing simplified statements may infer. To ensure that the plates are utilised most efficiently, they are usually ribbed to present the greatest possible surface area to the electrolyte.

During manufacture, a special reverse charging procedure may be used to transform the surface of the negative plate into a spongy lead mass. Alternatively, the crevices in the plate may be filled with red lead paste, which is readily reduced during charge to a spongy mass of pure metal.

To increase the current handling capacity of each cell, it is usual to use a number of interconnected negative and positive plates in a grid formation. (See figure 7.)

To allow them to be packed close together, yet without danger of shorting, they are usually separated by thin layers of wood or other selected insulating material.

ACID STRENGTH

The whole lot has to be suspended clear of the bottom of the case, so that metallic particles which may become detached from the plates will not collect on the bottom and ultimately cause a short-circuit and a discharge path within the accumulator itself.

The E.M.F. of a lead-acid secondary cell is normally reckoned at 2.0 volts, irrespective of its size. The actual current handling capacity is governed largely by the number, the size, the spacing and the nature of the plates.

For voltages greater than 2.0, it is usual to mount several cells, side by side, in the one large subdivided container. The cells are sealed across the top to prevent spilling of the acid and then connected permanently in a series arrangement, as already described for dry cells.

For radio work, accumulators delivering 2, 4, or 6 volts are usual, and either 6 or 12 volts for automobiles. These voltages require the use of 1, 2, 3, or 6 cells respectively.

Because the strength of the acid is affected by the chemical condition of the plates, it may be taken as a good guide as to whether the cell is fully charged or otherwise.

In new cells for car or radio use, it is usually arranged that the SPECIFIC GRAVITY of the acid be about 1.25 when fully charged (often quoted as 1250), 1.18 when half-charged and 1.11 when discharged.

MINIMUM VOLTAGE

Where cells are intended for industrial or home lighting purposes, acid of somewhat lower specific gravity is often specified in the interests of long service life.

To measure the specific gravity, a device known as a HYDROMETER is used. This is rather like an oversize syringe with a small glass float in the barrel.

The acid is drawn up into the barrel and specific gravity is indicated by the depth to which the float submerges in the acid. The upper section of the float is usually calibrated directly in terms of specific gravity, with "Full" and "Discharged" zones indicated for general guidance.

The EMF of a fully charged cell is often as high as 2.2 volts to begin with but rapidly drops on load to almost

(Continued on Page 83)

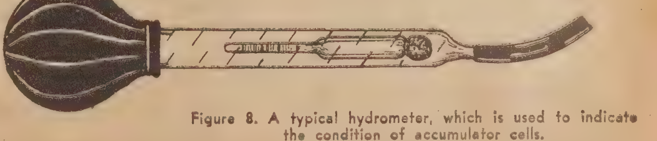

Figure 8. A typical hydrometer, which is used to indicate the condition of accumulator cells.

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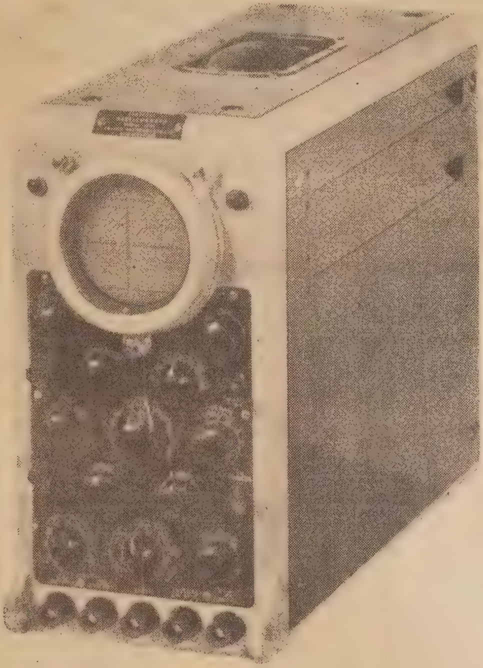

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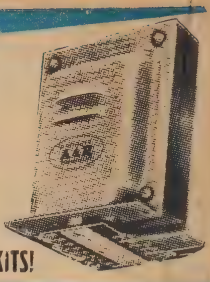

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1766	125	" " "	285—CT—285	
1767	"	" " "	300—CT—300	
1768	"	" " "	325—CT—325	
1769	"	" " "	350—CT—350	
1770	"	" " "	385—CT—385	
1771	150	200—230—240	285—CT—285	5v—3A; 6.3v—2A; 6.3v—CT—2A
1772	"	" " "	325—CT—325	ditto
1773	"	" " "	350—CT—350	5v—3A; 6.3v—3A; 6.3v—CT—3A
1774	"	" " "	350—CT—350	5v—3A; 6.3v—CT—3A; 2.5v—5A
1775	"	" " "	385—CT—385	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1776	175	200—230—240	285—CT—285	All in this Section 5v—3A; 6.3v—3A; 6.3v—CT—3A
1777	"	" " "	325—CT—325	
1778	"	" " "	350—CT—350	
1779	"	" " "	385—CT—385	
1780	200	" " "	350—CT—350	
1781	200	" " "	400—CT—400	
1782	200	" " "	450—CT—450	
1400	250	200—220—230—240	565, 500 425 A side	2 x 6.3v—3A; 2 x 2.5v—3A: 5v—3A
1371	300	" " " "	1000, 850, 750, 600, 500 A side	— — —

TYPE 931-15: 20 watts
Prim.: 4500 ohms P.P.
Sec.: 3.7 or 15 ohms
Resp.: 10-60,000 cps.
Valves: EL37, KT66, 6L6, etc.
19% Screen Taps.

TYPE 931-8: 20 watts
PRIM.: as 931-15.
Sec.: 2 or 8 ohms.
Resp.: As 931-15.
Valves: As 931-15.
19% Screen Taps

TYPE 921-15: 20 watts
Prim.: 6600 ohms P.P
Sec.: 3.7 or 15 ohms
Resp.: 10—60,000 cps.
Valves: 807, KT66, etc
19% Screen Taps.

TYPE 921-8: 20 watts
Prim: As for 921-15
Sec.: 2 or 8 ohms
Resp.: As 921-15.
Valves: As for 921-15.
19% Screen Taps.

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6BW6, 6V6, KT61, etc.
19% Screen Taps.

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp.: As for 916-15.
Valves: As for 916-15
19% Screen Taps

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P.
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Valves: 6V6, 6BW6, KT61, EL84, etc.
19% Screen Taps.

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Type 2505-15 for 3.7 or 15 ohms Sec.

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OUTPUT TYPE

TYPE 870 — 6 watts.
Prim.: 10,000 ohms P.P
Sec.: 2 or 8 ohms.
(for "Rola" 120X)

TYPE 871 — 12 watts.
Prim.: 10,000 ohms P.P
Sec. 2 or 8 ohms.

TYPE 872 — 12 watts.
Prim.: 10,000 ohms P.P
Sec.: 3.7 or 15 ohms

HI-FIDELITY +—1db 30-15,000 Cps

OUTPUT TYPE

TYPE 763 — 15 watts.
Prim.: 5000, 300 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

TYPE 920 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
Sec.: 500 250, 166, 125 and 100 ohms.

TYPE 897 —15 watts
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 896 — 15 watts
Prim.: 10,000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

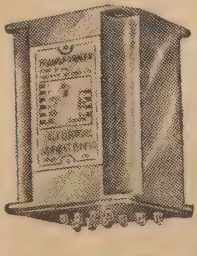
TV KIT

(Designed for use in T.V Circuit. Published by Philips Elect. Ind. P/L.)

P.T. 1790 P: 200, 230, 240V; S: 230-CT-230 350 mA; F: 2 x 6.3V at 6A.
O.T. 2507 To Philips Specification.
Z. 1090: 3 Hys-300 mA Choke, D.C. Res. 50 ohms.

MATCHED KIT (For Mullard 20W EL34 Amp.)

P.T. 1783 P: 200-230-240v., 50cps.
S: 410-CT-410v., 180 mA
F: 5v-3a; 6.3v.-CT-4A; 6.3v -CT-2.5A (Electrostatic Screen)
Z. 1092. 10 Hys-180 ma Choke, D.C. Res., 200 ohms.
O.T. 921 See above Tested and approved for use in this Amp. by Technical Service Dept. of Mullard (Aust.) Pty Ltd



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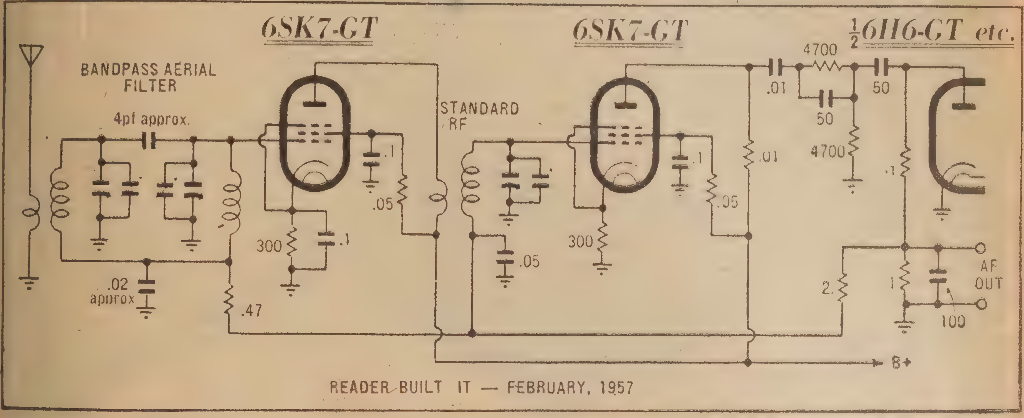
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

WIDE-RANGE TRF TUNER USES BAND-PASS COILS



A reader from Beverly Hills, NSW, has written to tell us of a TRF tuner which he has built up, as a development from the R, T & H Wide-Range superhet tuner. Details of the circuit are shown above.

THE reader in question is Mr. W. Penburthy, of 3 Lyla St., Beverly Hills, NSW.

Mr. Penburthy says that he particularly wanted a TRF tuner, not because he doubted claims made for the superhet but because he wanted a push-button tuning system.

Without going to a great deal of trouble with temperature-compensated tuning circuits, &c., a superhet might have been unsatisfactory by reason of oscillator drift. A TRF tuner seemed to offer the easy way out, since drift problems would probably be less evident.

Past experience had indicated, however, that a TRF tuner using even a three-gang capacitor could not be relied upon in his district to separate cleanly the local B-class stations.

POOR CIRCUIT "Q"

He felt that this was due mainly to the poor "Q" of the third tuned circuit, because of loading of the diode detector. As far as selectivity was concerned, it was making only a very small contribution to the end result.

Thinking over the problem, Mr. Penburthy reasoned that it should be possible to use the bandpass coils and tuning system specified for the RT and H superhet tuner and employ resistance-coupling between the second RF stage and the diode.

In this way, all three tuned circuits could operate efficiently and there was the added possibility of achieving a selectivity curve with a flat top and steep sides. This due to the bandpass coupling.

A tuner built along these lines has proved very successful. It will separate all local stations cleanly and has enough sensitivity to bring them all in at ample strength to drive a standard amplifier.

Interstate reception is not required.

As is only to be expected, 10 Kc whistles are something of a problem but it is proposed to add a cathode-follower stage and a whistle filter, exactly as in the RT and H Wide-Range Tuner.

The original tuner does not use a 3-gang and trimmers as implied by the circuit, although most people would want to build it this way.

Instead, it employs a push-button switch system and collection of fixed capacitors and trimmers to resonate each coil to each of the local stations.

Mr. Penburthy says that this might be a rather expensive idea if all the necessary capacitors had to be bought over the counter. However, most of them have been collected over a period of time and he is just as happy to see them in the tuner as gathering dust in a box somewhere.

Although not specifically stated, the alignment procedure would presumably follow that suggested for the tuning circuits in the bandpass superhet.

WRITE FOR THIS FREE BOOKLET

SOME months ago a small paragraph appeared in the Trade section of our magazine concerning a small booklet "The ABC of Hi-G", which was obtainable free of charge by writing direct to Amplion (Australasia) Pty. Ltd., 88 Parramatta Road, Camperdown.

Mr. Maxwell Cutts, General Sales Manager of Amplion reports that as a result of this paragraph nearly 100 copies of the booklet have already been sent out — a response which he considers quite remarkable as the booklet has not been mentioned elsewhere. Requests came from every Australian State and New Guinea.

Any of our readers who would like one of these booklets can still do so by writing to Amplion.

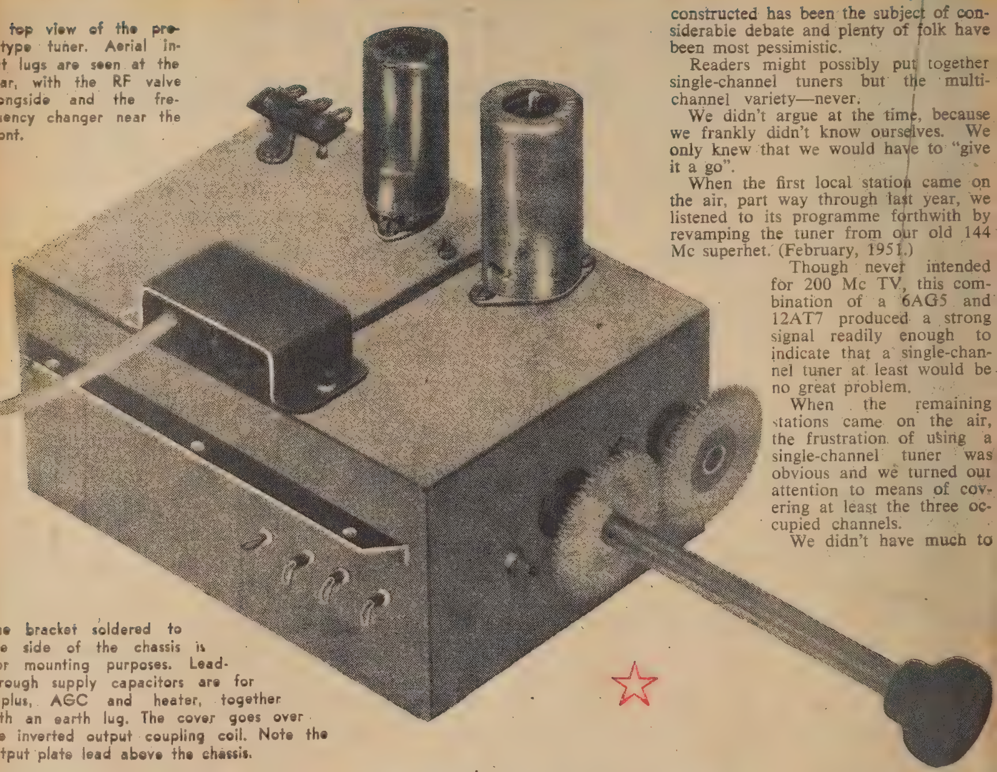
Amplion, of course, distributes the well-known Acos pickups in Australia, as well as a comprehensive array of crystal microphones.

CORRECTIONS

Two corrections to text in the January issue should be noted.

On page 61, line 3 column 1: "The gang" should read "The dial".

On page 67, the screen was inadvertently omitted from the second or pentode section of the 6BM8. The screen is connected directly to the high tension.



A top view of the prototype tuner. Aerial input lugs are seen at the rear, with the RF valve alongside and the frequency changer near the front.

The bracket soldered to the side of the chassis is for mounting purposes. Lead-through supply capacitors are for B-plus, AGC and heater, together with an earth lug. The cover goes over the inverted output coupling coil. Note the output plate lead above the chassis.

BUILDING A TELEVISION TUNER

This article deals with a subject which has not thus far been covered in our discussion of home-built television receivers — the construction of a multi-channel TV tuner. Enough information is given to duplicate our prototype or you can use the ideas to develop a tuner to your preferred own design.

by W. N. Williams

It will be recalled that a good deal of basic information was given in the December issue relating to the construction of a 5in disposals-type television receiver. Then, last month, we described an RF EHT supply and this present tuner more or less completes the picture.

Experienced readers should be able to go ahead and produce a receiver to this general pattern. Those needing more detailed instructions will perforce have to wait a little longer, until we can complete the development of a prototype which is sufficiently photogenic to present as a regular "build-it-yourself" project.

A SUB-ASSEMBLY

To develop an effective tuner was an essential part of the whole job—unless we were to commence all future articles with the words "first buy a tuner".

As we have explained in other articles, television tuners are normally constructed as separate sub-assemblies, which are bolted to the main chassis and connected to the appropriate input, output and power leads.

This method ensures more precise construction, gives better shielding and helps to secure a very necessary degree of mechanical and electrical stability.

Whether such tuners could be home constructed has been the subject of considerable debate and plenty of folk have been most pessimistic.

Readers might possibly put together single-channel tuners but the multi-channel variety—never.

We didn't argue at the time, because we frankly didn't know ourselves. We only knew that we would have to "give it a go".

When the first local station came on the air, part way through last year, we listened to its programme forthwith by revamping the tuner from our old 144 Mc superhet. (February, 1951.)

Though never intended for 200 Mc TV, this combination of a 6AG5 and 12AT7 produced a strong signal readily enough to indicate that a single-channel tuner at least would be no great problem.

When the remaining stations came on the air, the frustration of using a single-channel tuner was obvious and we turned our attention to means of covering at least the three occupied channels.

We didn't have much to go on, because most of the "pioneer" home builders were either using single-channel tuners still, or had purchased commercial multi-channel units.

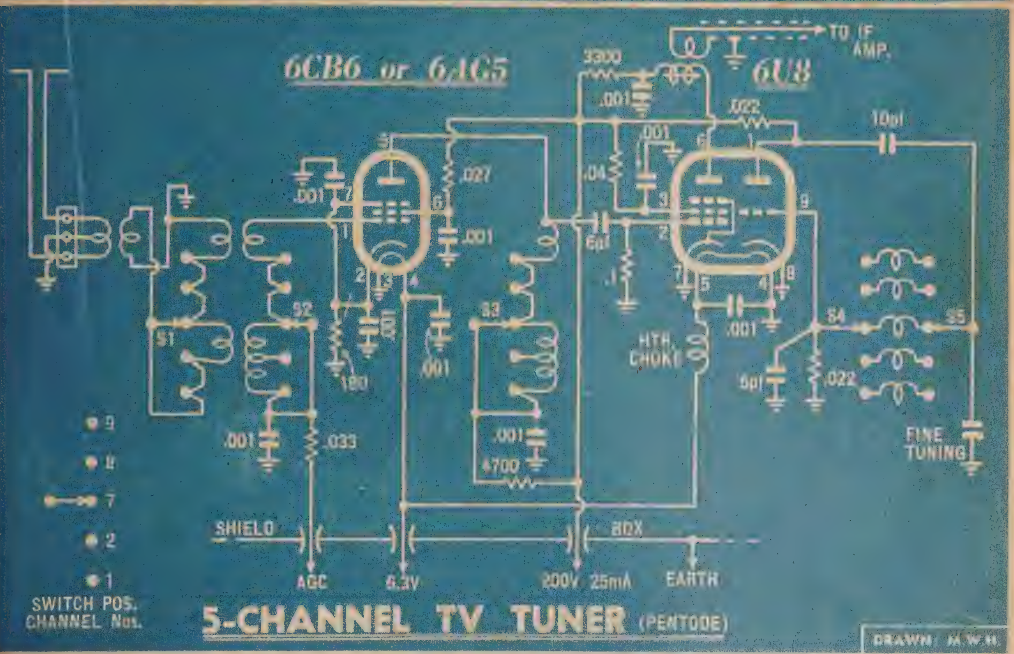
INCLUDING CHANNEL 2

To cover Channels 9 and 7 did not appear to be an insuperable problem, because they were close enough together to be tuneable with a midget variable capacitor. But to include Channel 2 at 60 Mc odd was quite another matter.

Our first attempt was a kind of "two-in-one" tuner, involving a couple of triode-pentode mixers and a twin triode to provide two separate RF amplifier stages.

The idea was to use one grounded-grid triode and one mixer to cover Channel 2, the other valve sections to cover Channels 7 and 9. The oscillators were to be tuned by a single

CIRCUIT PROVIDES FOR UP TO FIVE CHANNELS



Here is the complete circuit diagram of the prototype tuner. It provides for five channels but could be restricted to three or expanded, with some extra work, to include more. No trimmers are used, all alignment being carried out by expanding or compressing the coils. The RF pentode is easy to get into operation but could be replaced for difficult areas by a cascode amplifier stage.

knob controlling a butterfly or split-stator capacitor, with a wiper switch to divert DC to one pair of tubes or the other.

Aerial input terminals and IF output were to be commoned, to avoid any further switching problems.

EASY WAS HARD

The idea seemed very attractive at first approach and we built up a prototype tuner to try it out. As often happens, however, the "easy" way turned out to be the hard way, and, after struggling with instability and lack of gain for a week or so, we tossed the whole thing over and prepared to start again along more conventional lines.

Since the turret idea seemed to be out of the question for mechanical reasons, we turned attention to the use of a switch and the techniques employed in commercial incremental tuners.

The amount of design in detail in many of these tuners is rather appalling at first glance, while the switch sections are "de-luxe" versions of the familiar wave-change variety. Could standard switches be used and the whole thing simplified to suit home construction? That was the problem we had to solve.

Since there was no other obvious way to find out, we set to work again, building the new tuner around standard switch wafers, a triode-pentode mixer and a straight pentode RF stage.

We preferred the pentode initially, because they are easy to get going, many readers have them on hand and signal-to-noise ratio is not likely to be a problem in many suburban areas. The much-favored but trickier cascode could come later, after any "bugs" were removed from the switching arrangements.

As it transpired, the tuner proved to be remarkably easy to get going. Within a few minutes of switching on, Channel 9 was coming through at excellent strength, followed later by Channel 7 and Channel 2.

Once tuned, the signals were rock steady and the switch could be clicked back and forth without the slightest suggestion of tuning drift. Contrary to the earlier experience, the circuit was entirely free from instability.

IT LOOKS GOOD

These were the preliminary observations and, as yet, we have not had the opportunity of backing them up with detailed tests on such things as signal-noise ratio, AGC characteristic, tendency to cross-modulation, and so on, all of which have caused their share of headaches in commercial receivers.

In fact, because of the pressure of other work and the intervention of holidays, it may be some time before we can complete these tests and make any refinements which may prove to be desirable. For the same reason, modifications to take a cascode RF stage may be delayed.

In the meantime, we reckoned the tuner sufficiently promising to warrant this preliminary description, or "progress report"—call it what you like.

Coupled to the RT and H fan aerial in an ordinary suburban location, it has already demonstrated its ability to bring in copious quantities of signal on the three active channels.

It uses relatively few parts and, allowing for some which may already be on hand, should cost very little to build.

THE CIRCUIT

On the other hand, if you live in a difficult area, or have strong feelings about using a cascode in the first stage, then some of the ideas may be useful as a basis for further development.

There seems to be no basic reason why a tuner patterned on the one described here should not have as good an RF performance as an expensive commercial unit.

However, let's look at the circuit in its present form commenting, as we go, on various components.

The aerial input circuit provides for a balanced feedline, connection being made to a 3-tag strip on top of the chassis.

To avoid the difficulties which balanced input would introduce with subsequent switching and trap circuits, the incoming signal is passed immediately through a small balance-to-unbalance input transformer. One side of the secondary is earthed directly, the other side passing to switch section S1.

Should it prove necessary, IF or other

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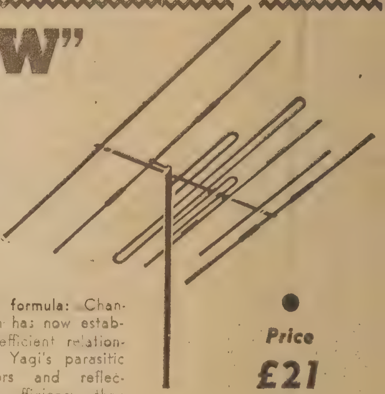

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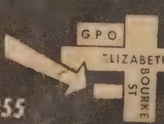


PLEASE INCLUDE POSTAGE OR FREIGHT WITH ALL ORDERS

trap circuits can be included readily in this last mentioned lead.

If coaxial input is required, it would seem logical to connect the cable between the earthed centre tap and one end of the primary.

The balance-to-unbalance transformer is a simple little affair comprising two windings, each of eight turns, wound one-over-the-other on a core from a 30 Mc IF transformer. The outer winding, being the primary, is centre-tapped.

STANDARD SWITCH

Whether this little device is optimum or not we cannot say for certain, being one of several things we have yet to check in detail.

It appears to give excellent signal transfer on all Channels and that was the prime requirement for our initial tests. By all means experiment further with it, if you feel inclined.

Switch S1, S2, S3, etc., are all standard 2 x 5 Oak switch sections. Their use warrants a word of explanation.

We had in mind originally to provide for only three Channels, using alternative positions on 2 x 5 switch banks, to isolate the coils. It turned out later that interaction between coils was not a problem and that all five positions might just as well be utilised.

But which of the 10 projected Channels should have preference?

Talks with folk who might know the answer yielded only negative information. Further allocation of Channels and licences is more a political than a technical matter at the moment.

Channel 10 is mixed up at present with aircraft DME activities and seems likely to remain that way. Certain other Channels aren't scheduled for release till 1963. It seemed that, over and above Channels 2, 7 and 9 which are already in use, the ones most readily available and likely to be allocated are 1 and 8.

For better or for worse, therefore, we settled for Channels 9, 8, 7, 2 and 1 in that order around the switch.

We could, of course, have used 11 x 1 switch banks and given ourselves a lot of extra worry wiring in the extra coils. While justified commercially, we could no be convinced about the virtues of such a scheme for the homebuilder. By the time all the extra Channels come into use, the tuner will probably have been wrecked and rebuilt twice over.

COUPLING LOOPS

As indicated in the circuit and switch wiring diagram, a two-turn coupling loop is connected between earth and the contact on S1 nearest the common lug. This loop couples to the first section of the RF grid coil.

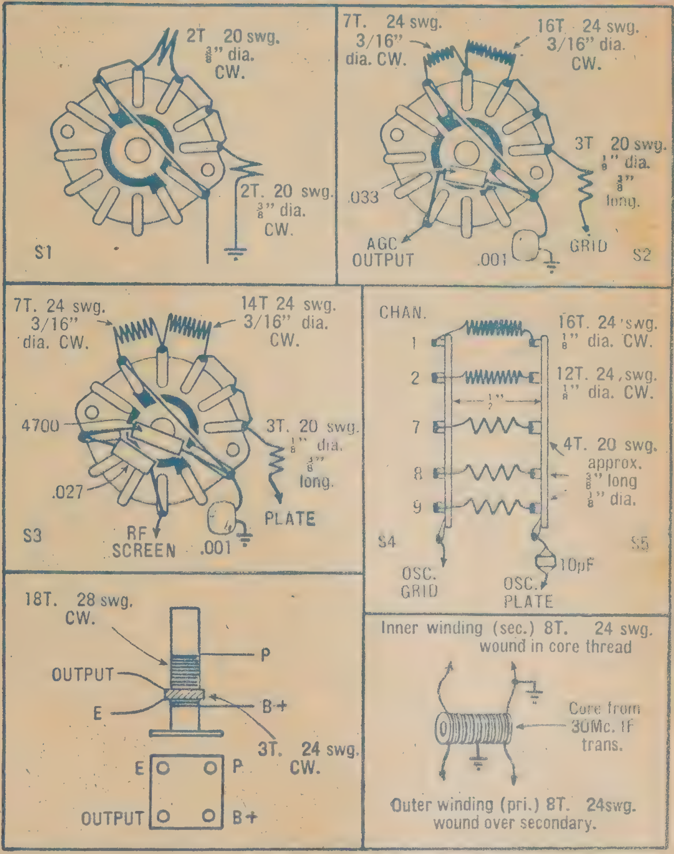
Its earthy end is anchored to a short length of heavy busbar soldered vertically to the chassis.

This order of coupling is maintained for Channels 8 and 7 but, as the switch is rotated to the Channel 2 position, it brings another two primary turns into circuit.

Whether this is strictly necessary could be debated but, since the first mentioned turns have to be supported somehow, it isn't hard to use a switch section for the job and make it perform the additional function.

One point is most important. Make sure that both sections of the primary are wound in the same direction, otherwise they will oppose rather than assist one another.

DETAILS OF THE SWITCH WIRING


2T 20 swg. 3/8" dia. CW.
2T. 20 swg. 3/8" dia. CW.
S1
7T. 24 swg. 3/16" dia. CW.
16T 24 swg. 3/16" dia. CW.
3T 20 swg. 1/8" dia. 3/8" long.
.033
AGC OUTPUT
.001
GRID
S2
7T. 24 swg. 3/16" dia. CW.
14T 24 swg. 3/16" dia. CW.
4700
3T. 20 swg. 1/8" dia. 3/8" long.
.027
PLATE
S3
RF SCREEN
.001
CHAN.
1
2
7
8
9
16T. 24 swg. 1/8" dia. CW.
12T. 24 swg. 1/8" dia. CW.
1/2"
4T. 20 swg. approx. 3/8" long 1/8" dia.
S4
S5
10pF
OSC. GRID
OSC. PLATE
18T. 28 swg. CW.
P
OUTPUT
E
B+
3T. 24 swg. CW.
E
P
OUTPUT
B+
Inner winding (sec.) 8T. 24 swg. wound in core thread
Core from 30Mc. IF trans.
Outer winding (pri.) 8T. 24swg. wound over secondary.

Details of the switch wiring and the coils. Much of the active inductance is contained in the connecting leads and switch mechanism so that the data will be correct, only if the original layout is duplicated in every detail. Figures refer to inside diameter of coils—that is, diameter of former on which they are wound.

In the RF grid circuit, the basic coil serving Channel 9 mounts directly between the first switch contact and the grid pin. The return circuit is through the switch to the common lug right alongside, thence through a midget .001 mfd ceramic to chassis.

A decoupling resistor from the junction to a vacant lug on the other part of the switch bank provides a convenient means of injecting AGC voltage to the grid. If AGC is not required, the remote end of the resistor can simply be earthed.

It is most important that the basic Channel 9 grid coil terminate on the lug adjacent to the common connection, to secure the shortest possible path through the switch.

The effect of switch inductance will be apparent immediately from the fact that almost direct shorting links to adjacent contacts are sufficient to lower the resonance of the grid circuit to Channels 8 and 7.

Additional coils, recognisable as such, are necessary to resonate Channels 2 and 1. These coils must be wound in the direction which continues that already established for the basic Channel 9 grid coil.

IMPORTANT WIRE

In wiring S1, S2 and S3, it is important to run a direct shorting wire from the common contact across to the Channel 1 lug, so that unused inductance will at all times be shorted out. Failure to do this permits an obscure absorption effect which almost completely kills the high Channels.

If the RF socket is wired as shown in the circuit, either the older 6AG5 or the modern 6CB6 can be plugged in. The two types appear almost identical from characteristics and show no significant difference in performance.

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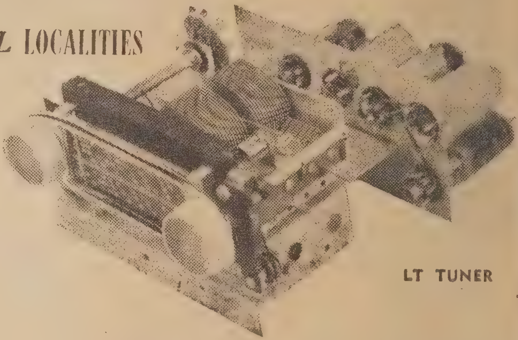
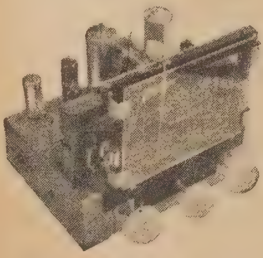


LT TUNER



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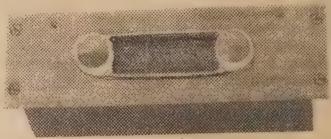

P.M. No. 3

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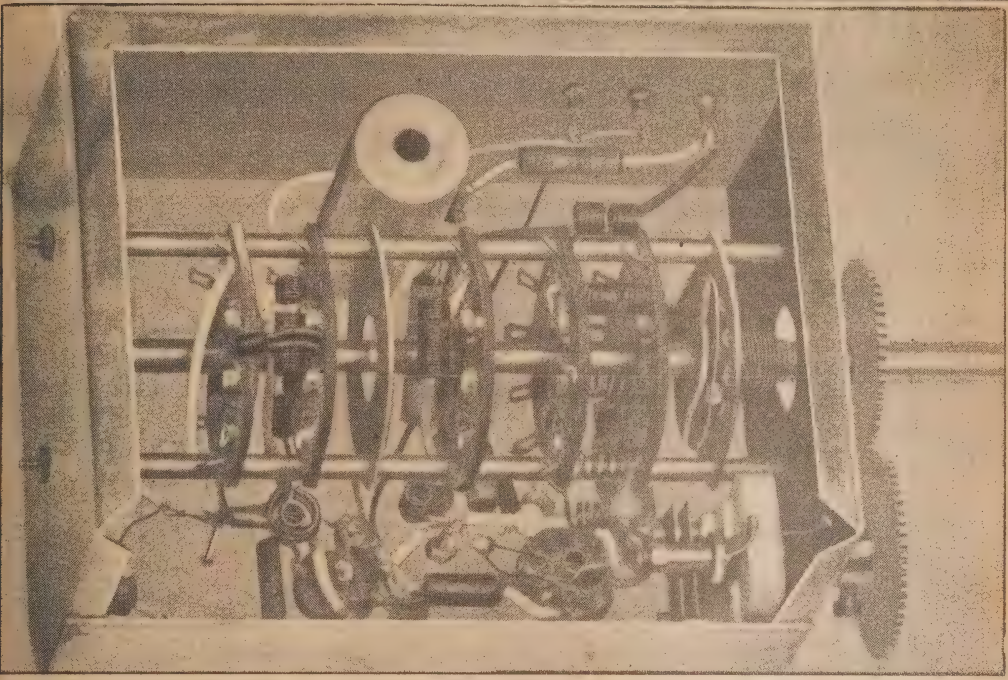
CLOSE-UP VIEW SHOWS UNDERSIDE OF TV TUNER



The underside of the prototype tuner. Valve socket wiring should be completed before the switch is put in position. After completion and adjustment, a cover attached to the flange with self-tapping screws will exclude dust and provide complete shielding.

Other miniature high-Gm pentodes like the 6AK5 could conceivably be pressed into service but we did not have the opportunity to try them.

Heater, cathode, screen and suppressor connections are all bypassed with .001 mfd capacitors. It is intended that these should be of the miniature high-K type, soldered directly between the socket pin and the chassis. Don't try to use mica capacitors. They are too bulky and cannot be relied upon at 200Mc to have sufficiently low self-inductance.

The best way is to buy new ones, although suitable ceramic types can often be retrieved from disposals gear.

The switch and coil arrangement in the RF plate circuit is virtually a repeat of the RF grid circuit. Details are given in the switch wiring diagram and require little additional comment. Note that the HT decoupling resistor and the screen supply resistor terminate on vacant switch lugs.

STANDOFF MOUNT

To facilitate mounting the basic Channel 9 RF coil, we used a small ceramic stand-off pillar immediately beneath the switch lug. This provided a junction for the plate lead, the coil and the coupling capacitor to the mixer grid.

This latter capacitor should swing across the mixer socket directly to the grid but just clear of the wiring. Its position can be varied slightly later to give more or less incidental coupling to the oscillator wiring.

For the frequency changer, we suggest that you purchase a new triode-pentode mixer rather than try to get by with an older twin triode. These new valves have an excellent oscillator section, while the pentode mixer is itself less prone to instability.

OSCILLATOR CIRCUIT

The oscillator circuit is the popular Colpitts of Ultraudion arrangement. (See "Course In Television").

We deliberately avoided an incremental type inductor in this circuit to allow each Channel to be tuned independently. Each Channel has its own oscillator coil which swings directly between the lugs on two adjacent switch banks. The diagram gives all necessary information relating to wire gauge and number of turns.

A 5pf capacitor from grid to earth provides a small amount of fixed capacitance, while a small variable capacitor on the other side of the circuit serves as a fine tuning control.

This capacitor must be small and it must be good. Large "reaction" types with sloppy bearings are quite useless. You may be able to buy an imported capacitor for stripping to the right size or you may find a suitable one in disposals gear. You want nothing larger than a 2-plate capacitor, with the plates spaced about one-eighth inch apart.

The oscillator circuit might be criticised on the grounds that it could use more capacitance in the interests of stability; also that the fine tuning gives too great a range.

Both criticisms could be justified, at least in part. However, we suggest that you start off with the specifications given and let the wide tuning range of the midget capacitor help you find the various Channels. It will be time enough later to start adding C and pruning the coils.

Quite deliberately, we avoided using capacitive trimmers in the circuit or specifying brass screws to vary coil inductance. Such measures may be justified in factory-built units where alignment time is money. In a home-built unit, they would double its mechanical complexity and contribute nothing to the ultimate performance.

All adjustments are made by the simple expedient of expanding or compressing the coils.

OUTPUT COIL

Output from the tuner is through a home-wound coupling coil, built up in a commercial minature can. The secondary feeds through a short length of coaxial cable to the primary of the first transformer in the video IF system. The output coil is peaked by the core supplied.

It will be noted, in passing, that a choke is shown in the mixer heater lead. We wired this in as a "conventional" precaution against interstage coupling and/or oscillator radiation. The particular choke came from disposals gear but consisted of about 30 turns of 30-gauge enamel. It could be wound over any large value resistor, acting as a former.

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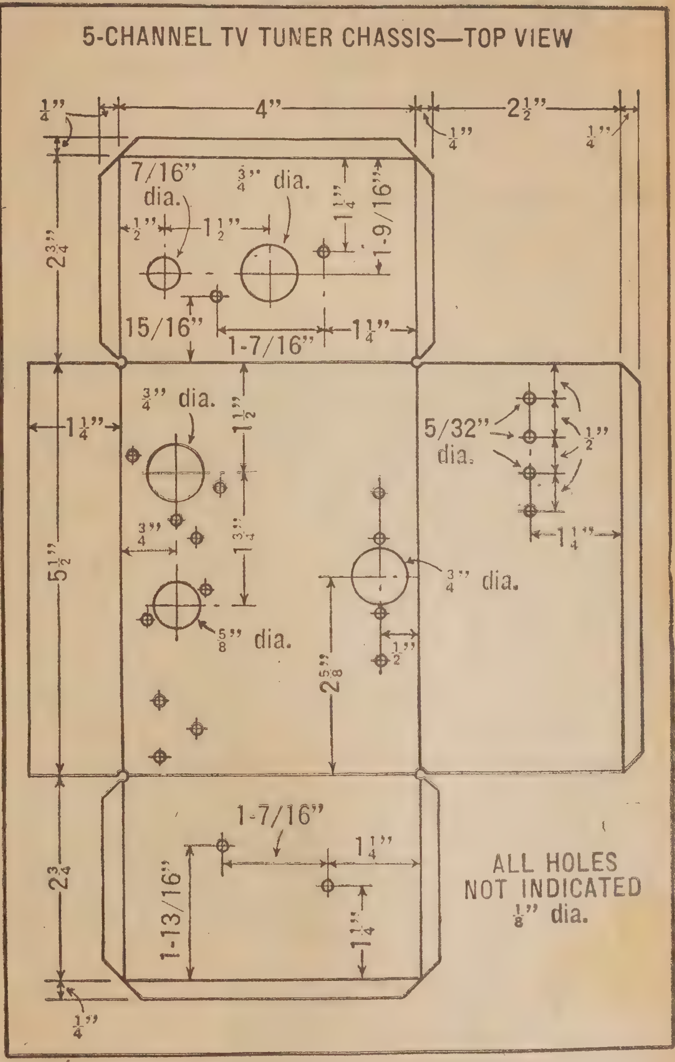

This drawing should enable you to make up your own chassis, preferably from brass or tinplate. Aluminium is not recommended because earth return circuits cannot be soldered directly to it.

The outgoing heater, AGC and HT leads pass through .001 mfd. lead-through capacitors soldered into the side of the chassis box. These are convenient and very effective in terms of electrical filtering.

So much, for the moment, for the electrical circuit. Although the layout is logical enough when viewed as a finished unit, it was quite a major task originally to determine a suitable shape, size and method of construction.

THE LAYOUT

We had to keep in mind, not only a disposals type receiver but the full-scale variety, where the tuner may have to tuck in beneath the curvature of a large television picture tube.

The general appearance of the resulting prototype is apparent from the accompanying picture. The tuner is intended to mount on the right-hand side of the chassis, viewed from the front, for which reason the valves are mounted along the right-hand edge.

To conserve height, the output coupling coil was mounted upside down in the space alongside the switch.

We are quite happy with the ultimate result and suggest that readers simply follow our lead in this respect.

The chassis box for the original was made up from about 23 or 24 gauge brass, though tinplate would do equally well and tarnish less readily. Brass or tinplate is recommended because seams can be soldered and earth connections made directly to it.

Mark out to the dimensions shown, then cut around the outlines, taking care not to spring the wanted edge of the metal. This done, polish both sides to improve its subsequent appearance and to simplify soldering.

To fold the sheet, you will need a bench vice and a few scraps of hardwood. Apply pressure to the sheet only with a block of wood and don't tap the metal directly with a hammer. Hammer marks are practically impossible to remove, once made.

A SOLDER JOB!

Having folded the box, get to work with flux and a plumber's iron and sweat the seams. Wash away surplus flux and clean the box again with metal polish.

One side of the box is deliberately forshortened to give access to the wiring.

Next operation is to punch for the sockets and drill mounting holes to bring the pins to the positions indicated.

The position and angle for the switch is also apparent. If the oscillator leads are any longer than the approximate 3/8 to ½in allowed for, the tuning range will be upset.

Note that the switch does not mount by its spindle. Instead, the clicker plate and wafers lock to a threaded rod which passes right through the chassis from front to rear. This method holds the switch absolutely rigid and also stays the chassis box.

You will need a switch with a 4in tongue, a foot of 1/8in brass rod, a few inches for 3/16in brass tubing for bushes and a Whitworth or BA die to thread the ends of the rod.

Assuming that you duplicate our layout, you will need switch spacers as follows:

Either side of the clicker plate and between the oscillator sections, ½in (standard switch spacers); between S4-S3 and S3-shield plate 5/8in; shield plate to S2 3/8in; S1-S2 ¾in; S1-end plate approx. 1¼in.

Assemble the switch in position and make any necessary corrections to prevent the box being "sprung" when the rods are tightened up.

At this stage, you may as well solve the drive problem to the fine tuning control. The easy way is to bring out two separate spindles but it isn't the "fashionable" way. Our own solution worked out very neatly.

We bought a few inches of 3/8in brass tube, which slipped nicely over the switch shaft. Then we bought two 1½in Meccano gear wheels, drilled and punched out the centre bosses and found that one of them was a tight push fit over the 3/8in tube.

DRIVING WHEELS

The second wheel was filed out carefully and fitted over a ¼in brass boss taken from an old knob. Next the fine tuning capacitor was mounted in the appropriate position and the second wheel locked to the shaft.

When everything was lined up, the wheels were removed, sweated to the shaft or boss and the job was done. We had a concentric drive as smooth as

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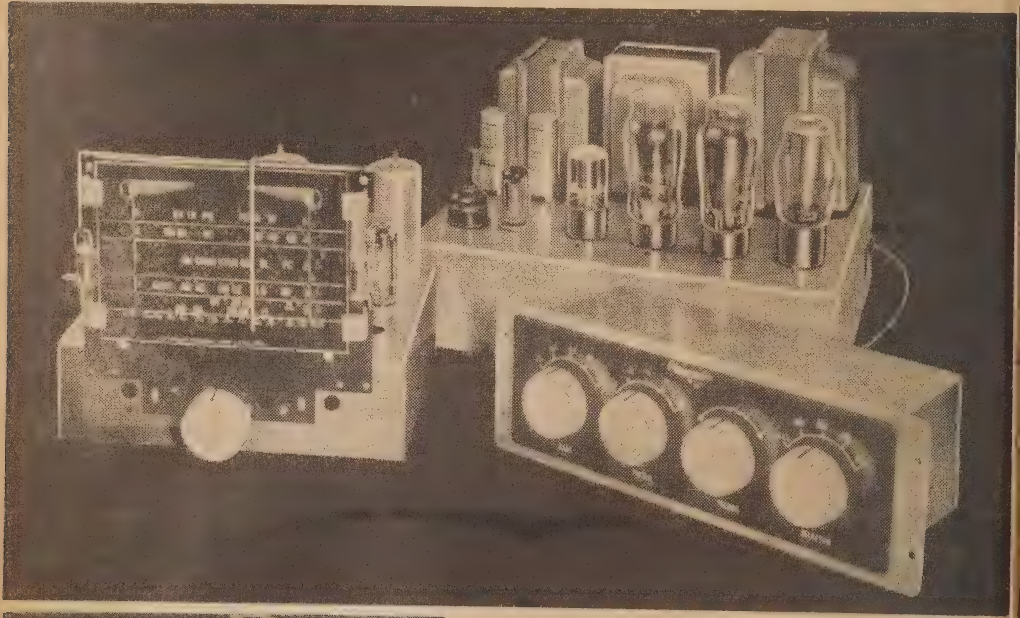

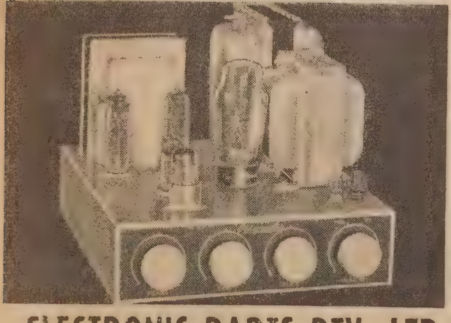

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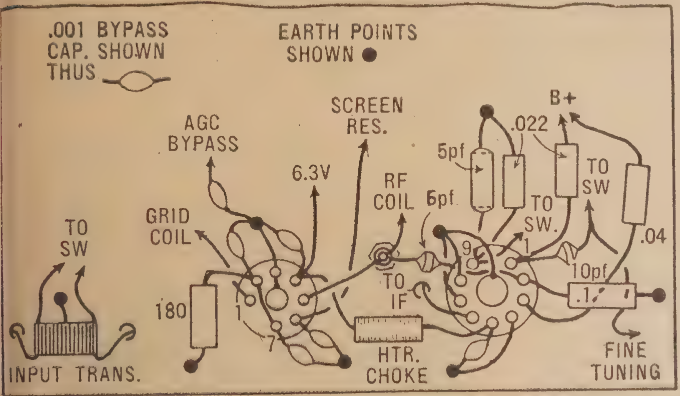
could be wished for. To be sure, the shaft diameters are not the same as used for twin potentiometers but it should not be too difficult to provide a couple of suitable knobs.

The control shafts in our prototype are very long, actually 4½in from the front of the box to the tip of the switch shaft. This involved fitting and sweating an extension to the shaft but we wanted to make it long enough to get out from under a picture tube and safety glass inclined forward as in many commercial receivers. However, that is another story.



This layout diagram indicates the position of the various components around the sockets. The essential simplicity of the wiring is evident.

Many readers will doubtless have seen other ideas for manipulating fine tuning controls. Some tuners use a dielectric blade passing between two fixed plates. Others use a moving metal vane. Still others have a cam arrangement operating an earthed plunger inside a tube-like capacitor.

All these schemes are permissible but take our tip: If you want to use one of them, work it out completely on a scrap of metal before you make up your box. If you don't, the front of your tuner is likely to finish up looking like a sieve.

Having completed these mechanical details, the final and rather simple job is that of wiring. You will need a good hot iron or a quick-heating type to make the direct chassis connections. However, if you can borrow a miniature type for other work, it will make the wiring job on the sockets and coils ever so much simpler—and cleaner.

Leave the switch out for the time being and wire up the sockets, following our suggested layout diagram.

FURTHER WIRING

Make and fit the output coil, taking care to run the mixer plate lead out through a hole in the top of the chassis to the base of the coil. Only after all this is completed should the switch be added.

Connect the coupling capacitor to the common lug of S5, add a short flexible lead for connection to the fine tuning control and slip S5 into position. Put in the spacers either side of the clicker plate and push the side rods partly through.

Next add a lead to the common lug of S4, for ultimate connection to the oscillator grid. Slip this bank into position but don't worry yet about the oscillator coils. They can be added later.

The shorting leads, resistors and bypass capacitors can well be added to the remaining switch sections before they are placed in position, leaving the the coils to be added later. Instal the switch banks, slip in the prepared spacers, push the rods through and tighten the end nuts.

Complete the connections between the switch banks and the rest of the wiring, then make up and solder in the coils for Channel 9. Note that the ends of the coils are extended by about ¼in. to allow them to be slipped into the various lugs and sweated in position.

The slight extension also allows the coil to be sprung a little to vary its L and C characteristics. After springing the coils, by the way, it is wise to melt the solder and relieve any strain at the lugs.

As will be apparent, all tuning coils are self-supporting.

MAKING IT GO

With the Channel 9 coils in position, and, assuming a receiver to make the test, the tuner can be put into operation.

First job is to peak the output coupling transformer. Lacking other means, this can be done by feeding an oscillator fundamental or harmonic at about 33Mc from the mixer grid through the IF channel. The receiver's audio amplifier or a signal tracer can be transferred temporarily to the output of the video detector, so that the amplitude modulated test signal can be heard.

Lacking a 5.5Mc beat, any signal that penetrates the FM sound Channel would do so by purely random means.

With the output transformer peaked at least temporarily, connect to an aerial and try for the Channel 9 signal. Squeezing together the turns on the oscillator coil will lower its frequency, opening them up raises it. Having found the station, set the coil so that best sound is heard with the fine tuning trimmer at half setting.

A meter on the 10V.DC range, clipped between one side of the ratio detector and earth will indicate change in signal strength as tuning is manipu-

(Continued on page 105)

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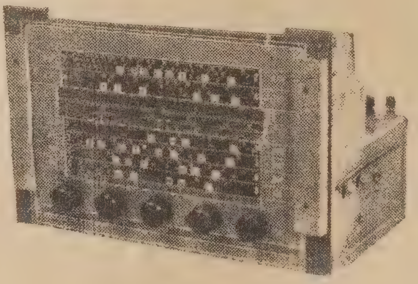

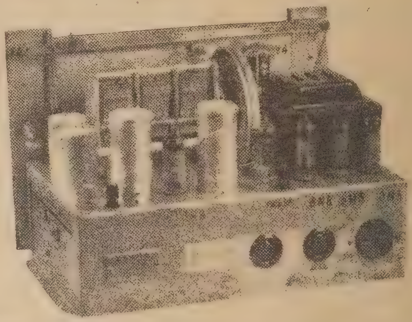

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Here's your answer, Tom!

Once again Tom has put pen to paper in his quest for knowledge. Most of this month's queries come from a reader in New Zealand and indicate that he is a step or two past the beginner stage. One question is really too involved for this page but we have answered it in simple terms to give beginners who may have been prompted to ask a similar question some idea of the process involved.

What causes the increase in hiss level of a radio when a station is tuned in? How can this effect be reduced for distant stations in which case it is most noticeable?

The answer to your query Tom, could well be that you have a receiver with a poor signal-to-noise ratio. However, there is more to it than that.

Every receiver has a certain amount of inherent noise, due to random electron movement in the valves and tuning circuits. The higher the gain of a receiver — that is, the more sensitive it is — the more apparent the noise becomes.

You hear a hiss as a very weak station is tuned in because high frequency noise components in the receiver heterodyne (or beat with) the incoming carrier to produce extra audible noise in the loudspeaker. That answers the first part of your question.

The hiss is naturally at its worst when the receiver gain is near to maximum.

However, on a stronger signal, the automatic volume control action in a well aligned receiver reduces the gain in the early stages to prevent the later valves being overloaded. As the gain is reduced, so the noise level diminishes.

Using a good outdoor aerial improves the signal-to-noise ratio and often causes the noise level to be reduced to such low order that it becomes almost inaudible in the presence of a strong signal.

If you live in an area where signals are weak most of the time, we suggest that you make sure first of all that you have an effective aerial and earth.

Then, if results are still poor as compared with other sets in the district, you should have your set checked over or replace it with one more suited to long distance reception.

* * *

How does one calculate the value of the resistors in the negative feedback network from voice coil to cathode of the first stage?

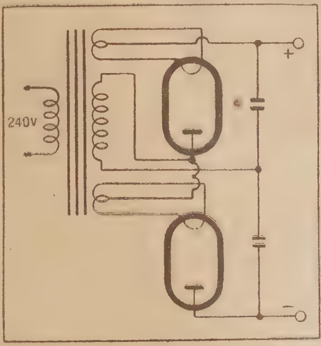
It would be impossible to give you an answer in simple terms, Tom, but broadly, here is the process involved:

One would normally calculate first the overall gain of the system in terms of RMS input for full output. This would indicate whether the gain could be reduced little or much by feedback without rendering the amplifier too insensitive for use with whatever pickup, tuner, etc. the constructor has in mind.

Some assessment has to be made also, in the light of experience or by involved graphical methods, as to the amount of feedback which can safely be applied without promoting instability.

In the light of the foregoing decisions the voltage gain must be calculated between the point in the circuit where the feedback is applied and the point from where it is derived.

Knowing this it is a simple proportion sum to work out how much of the output voltage must be fed back to the point of application to give the necessary reduction in gain.



A circuit of the basic voltage doubler discussed in the text.

But here's the point Tom: Although the resistor values are ultimately just a matter of simple proportion, you can't determine what that proportion is without the stage gain calculations just outlined.

It's like opening a combination safe. It's easy, when you've found out the combination. But that's the hard part.

* * *

What would be the greatest amount of feedback that could be applied using a typical 20 watt PA type of output transformer?

Once again, Tom, a number of variable factors are involved, and it would be impossible to give any specific figures. Conditions are likely to vary with individual transformer makes, the exact type of feedback circuit, the valves used and so on.

However, as an example, using a PA type of output transformer in an ordinary 3-stage amplifier such as the Playmaster No. 2, one should be able to apply about 15 db of feedback without instability problems.

* * *

Is the Williamson amplifier still one of the best designs from the point of view of lowest distortion and widest frequency range? Do any of the Playmaster amplifiers equal or better its performance?

The Williamson amplifier, Tom, is still a very good amplifier in terms of distortion and frequency range, but this is where its good points end.

We feel that there are much simpler ways of achieving equivalent or even better results, with less tendency to instability, and greater power output with smaller power supply requirements.

Modern Ultra-Linear amplifiers, including several Playmasters, achieve these results. The Ultra-Linear output stages are often credited with less total harmonic distortion than triode output stages.

In all fairness, Tom, it must be pointed out that the Williamson is now quite an old design. Engineers have learned a lot of tricks about feedback loops, valve operation and transformer design since D.T.N. Williamson made his epic contribution to the art.

* * *

I have noticed that the output from the Rambler portable is more distorted with series-connected filaments when used with a fresh A battery and a rundown B battery, than with parallel-connected filaments under the same conditions. What is the reason for this?

With parrallel-connected filaments, Tom, the bias is derived from the B-battery. As the battery voltage drops, the bias decreases in direct proportion, balancing out the effect of a low high tension voltage.

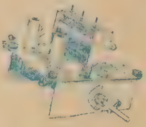
In the case of a series-connected filament network, the bias is derived from the fact that the filaments are wired so as to be progressively more positive commencing from the earthy end. This is equivalent to applying corresponding negative voltages to the grids, and the filaments are arranged so as to provide the correct bias in each case.

If the high tension drops and the bias remains high, due to the fresh filament battery, the result is increasing distortion due to over-biasing. These effects are evident mainly in the output stage, since the earlier stages are virtually at zero bias.

TYPE QWR5 (RF STAGE)

Q-PLUS PRE-FAB BANDSPREAD

TUNING UNIT



CHASSIS SIZE—7¼in x 5in x 2½in.

CUT OUT REQD.—6in x 5in (5in depth)

It is necessary that this be kept at the front of the chassis.

TUNING RANGES	Sensitivity obtainable
Pos 1 (max anti-clockwise) B/C Band	2uv
Pos 2 5.9—18.00 M/cs Cont. ..	2-4uv
Pos 3 14.8—15-6 M/cs—19M Band	2uv
Pos 4 11.5—12.1 M/cs—25M Band	2uv
Pos 5 9.35—9.9 M/cs—31M Band	2uv

DIAL—EFCO—USL46 Bandspread

WIRING CONNECTIONS—

Rear Corner	**Rear Centre**
Blue—IF Plate	Yellow—6.3v Fils
Brown—B plus 250v	Brown—Screen 80-100v
Yellow—AVC	

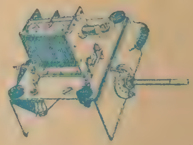
N.B.—Front aerial—earth all braids to main chassis.

VALVE TYPES REQUIRED—1 6BA6, 1 6AE8.

TYPE QW5 (Single Stage)

Q-PLUS PRE-FAB BANDSPREAD

TUNING UNIT



CHASSIS SIZE — 4½in x 3½in.

CUT OUT REQD.—3½in x 3in.

This unit is designed for mounting at the front of the chassis.

TUNING RANGE—	Sensitivity obtainable
Position 1 (maximum clockwise pick-up)	
Position 2 Broadcast	3-4uv
Position 3 14.8—15.6 M/cs 19M Band	16uv
Position 4 11.5—12.1 M/cs 25M Band	13uv
Position 5 9.35—9.9 M/cs 31M Band	10uv

WIRING CONNECTIONS—

Rear Corner	**Rear Centre**
Blue— I.F. Plate	Yellow—6.3V Fils.
Brown— B plus 250V	**Rear External Wafer**
Yellow—A.V.C.	Brown—Screen supply 80—100V
Front	White—I.F. amplifier screen
White— AERIAL.	

VALVE TYPES REQUIRED—1 6AE8.

Q-PLUS—Q WR5 QW5

PRE-FAB BANDSPREAD

TUNING UNITS

GENERAL

These units are designed to give better than commercial performance without the need for alignment equipment.

They come completely wired, ready for the addition of only valves and connection to the appropriate amplifiers. Initially they seem a little dearer than if you were to wire your own but remember the set is not only wired but aligned and tested to rigid sensitivity specifications

Radio, Television & Hobbies issue of December, 1954, gives a suitable circuit for these units.

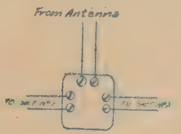
The unit should preferably be mounted to the front corner of your chassis and grommets are provided so that non-microphonic operation is achieved.

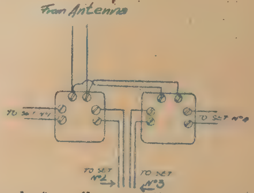
Hole centres of the RF stage are 4½in and 6¾in, whilst for the single stage unit they are 3in and 4in. Bandspreading—do not forget that 2 of these units, the QW5 and QWR5 have bandspread short-wave bands achieved electronically.

TV SECTION

N.B. It is suggested that the screen supply be obtained from B+ (250V) through a series resistance of 22K Ohms. (2W) with a 100K Ohms. (1W) bleed to earth

Q-PLUS — 2. 4. SET COUPLERS — TYPE SCI





Use 300 OHM Ribbon Leads for all connections. If any set outlet is not being used do not leave open leads attached to coupling terminals.

Q-Plus SCI TV set coupler is designed to permit simultaneous operation under suitable conditions of two or more receivers from a common aerial having a 300 ohm ribbon transmission line. Because this coupler uses non-inductive resistance units it does not affect the impedance characteristic of the transmission line. As a result, the bandpass response of the line remains essentially uniform over the VHF channels.

The Q-Plus SCI unit may also be used in combinations of two units for simultaneous operation of two to four receivers from the same antenna. In these combinations the couplers provide optimum distribution of the TV signal between the receivers and reduces cross-radiation interference between them.

N.B. The ability to receive signals for 2 or more sets is entirely dependent upon there being sufficient signal strength received in the antenna

R. W. STEANE & Co. Pty. Ltd. Auburn, Vic.

Designers are aware of this problem and often try to arrange matters so that A and B batteries will discharge at about the same rate. This isn't always easy to arrange, however, and other considerations may outweigh the desire to balance battery life.

* * *

Is it possible to modify the series-connected version to allow the B-battery to be used longer?

No, Tom, it would not be worthwhile fiddling with the circuit to try to compensate the disparity in bias and HT voltage.

A more logical approach would be to use A and B batteries with an approximately equal length of life. But, if you must have an odd combination Tom, be prepared to discard the B-battery a little earlier in the series-connected version.

After all the difference in life is not very great and the saving may not be justified on the score that the performance deteriorates with a run-down battery in either case.

* * *

I have noticed that the end of life of an A-battery in the Rambler is determined by the action of the oscillator, which ceases to operate when the A-battery is down to 6 volts, that is 1 volt per filament. Is this a reasonable figure for the oscillator to cease operating at, or should it be able to operate at lower A-battery voltage?

Before passing any definite opinion Tom, we would like to know whether the B-battery voltage was up or down, since this would have a considerable effect, in conjunction with the low A-battery voltage, in causing the oscillator to cease operating.

The efficiency of the oscillator with low A and B supplies would be to a large extent governed by the oscillator coil and by the converter valve.

However, generally we would consider the figure of 6 volts to be a reasonable point at which the battery may be considered to have arrived at the end of its useful life.

You may be able to coax a little more from it but the overall performance with the A-battery in this condition would be poor anyway.

* * *

When a resistor in a circuit is specified as being 1. meg, how can one tell what wattage rating this resistor should have?

Well Tom, in order to calculate the power dissipated in a resistor one would have to know either the voltage drop across the resistor or the current flowing through it.

However, in many radio receiver circuits, one could make an intelligent guess and arrive at an estimate of the power rating without knowing either the voltage or the current.

For example, resistors as high as the 1.0 meg that you mention can usually be of very low power rating, since very seldom is the applied potential high enough for the dissipation to be outside the capabilities of an ordinary half watt resistor.

This observation applies to the plate and screen loads of high-gain stages, since very seldom do these stages draw more than a milliamp or so of high tension current.

* * *

What is a thermistor?

A thermistor, Tom, is a device with a large negative temperature coefficient of resistance. In other words the resistance decreases as the current through the thermistor increases. In this respect its behavior is the exact opposite of a barretter or a metal filament lamp.

Thermistors may take several forms. The small types generally consist of a resistance element of a complex metal oxide compound enclosed in an evacuated or gas filled glass envelope. They look rather like a crystal diode.

The larger types may be heated by means of a heater element which is electrically insulated from the resistance element. This thermistor provides a very large change in resistance, which may be controlled by the power supplied to the heater.

Thermistors have numerous applications among which are the suppression of switching surges, the measurement of temperature and the stabilisation of the output of oscillators.

* * *

What is a voltage doubler?

A voltage doubler, Tom, is a rectifier circuit wherein the rectified DC output may be as high as twice the peak value of the AC input.

A basic circuit of a voltage doubler is reproduced, and referring to this, the action is as follows! On the positive half-cycle of the AC input when the top half of the transformer secondary is positive the top diode conducts and feeds a positive charge to the top plate of the top capacitor, a positive voltage is built up across this capacitor.

On the second half of the cycle, the bottom of the winding becomes positive and the lower diode conducts so that a positive voltage is fed to the top plate of the lower capacitance and a negative voltage to the lower plate.

As long as no current is drawn from the capacitors, each is capable of charging to a peak value of the AC input and the total voltage across them will be equivalent to the sum of the peak voltages.

When current is drawn from the circuit the voltage will drop by an amount which depends on the load current and the size of the capacitors.

The advantages of a voltage doubler circuit are that the transformer may be designed with insulation suitable for only half the voltage it would normally be called on to supply if a conventional rectifier and filter system were used.

If conventional diodes are used they cannot have a common cathode and must be supplied by separate heater windings. Consequently metal rectifiers are particularly suited for use in voltage doubler circuits.

* * *

What is automatic grid-bias?

Automatic bias, Tom, makes use of grid or plate current to bias the grid negatively.

In the case of the grid leak detector, the negative grid-bias is obtained by

(Continued on Page 105)

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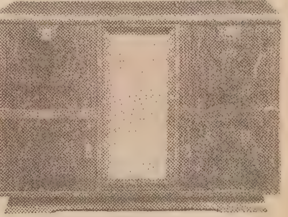

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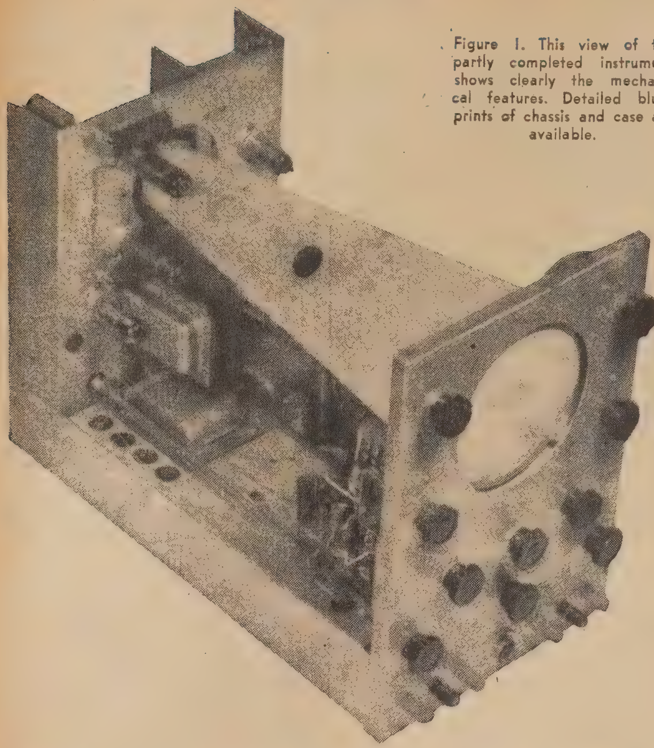

Figure 1. This view of the partly completed instrument shows clearly the mechanical features. Detailed blueprints of chassis and case are available.

NEW WIDE BAND OSCILLOSCOPE

A cathode ray oscilloscope for television receiver service and development work is presented here. It is a completely new design using components readily available to professional servicemen and home constructors through ordinary channels. The performance figures are similar to those of commercial instruments at several times the cost.

PART 1

by Maurice Findlay

THIS project can be regarded perhaps more seriously than the several practical articles which appear in each issue of Radio, Television and Hobbies, since its aim is to describe a major item of television test equipment with electrical and mechanical specifications enabling it to compete with factory-built instruments.

In terms of hard cash a television CRO for service work will cost up to £200. At least one such instrument is required for each service organisation and many larger establishments will require several. Therefore—the availability of a design which can be turned into a practical instrument at reasonable cost can mean the saving of substantial sums of money whether your organisation be small or large.

Some experience on the part of the constructor is assumed: it would be completely impractical to detail optimum positions of all small components and connecting wires in so large an instrument. However, the project is well within the scope of technicians and advanced amateurs who would normally be in a position to undertake the maintenance of television receivers. The techniques employed in the instrument are very familiar, in fact, to those used in the receiver itself.

Oscilloscopes of the type used for examining waveforms in audio amplifiers and broadcast receivers are familiar to technical people nowadays almost without exception. Whether they be large or small, expensive or cheap, the same general formula holds. A cathode ray tube with electrostatic deflection plates is the heart of the instrument. A high tension power supply delivering from 1 to 2 kilovolts is provided to accelerate the electron beam and enable it to be focused to a sharp spot o the screen of the tube.

The waveform to be examined rarely has sufficient amplitude to deflect the electron beam appreciably when applied directly to the deflector plates making it necessary to employ an amplifier. This amplifier is usually capable of accepting a signal with amplitude a fraction of a volt and delivering an output to the deflector plates of the CR tube of the order of hundreds of volts.

Without resorting to special techniques the amplifier of a simple instrument can be designed to amplify equally all frequencies between a few c/s and about 50 Kc/s. The more expensive instruments tend to cover a wider frequency range and some may cover up to frequencies of the order of 500 Kc/s.

AUDIO INSTRUMENT PRACTICE

Simple attenuators in the form of continuously variable potentiometers are used to vary the gain of the amplifier and frequently no serious attempt is made to render the frequency response of the gain control independent of setting. This is justified since audio instruments are mostly used for examining relatively pure waveforms, qualitative observations only are usually required, and amplitude measurements are left to meter indicators, such as valve voltmeters.

The signal to be examined is applied to the vertical deflection plates while a signal such that the spot move linearly with respect to time is applied to the horizontal deflection plates. The waveform of the signal appears on the screen in the familiar cartesian co-ordinates. When the signal is repetitive, as is usually the case, the time of the forward trace may be made to correspond with an integral number of cycles, the electron beam return quickly to the starting point and begin another forward trace. By this means a stationary pattern appears on the cathode ray tube.

The time base generators most fre-

ANALYSIS OF R-C COUPLED VOLTAGE AMPLIFIER

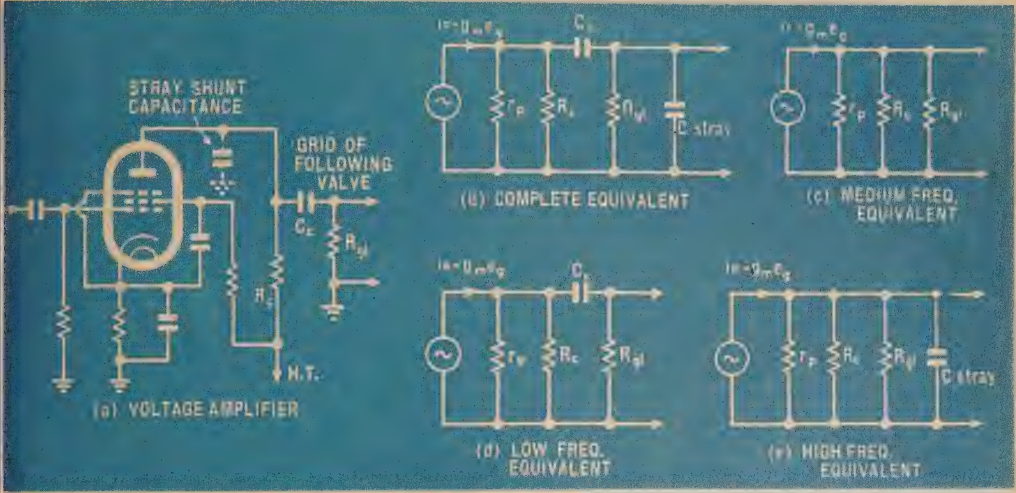

Figure 3. The behavior of an uncompensated resistance/capacity coupled amplifier can be analysed mathematically from these equivalent circuits.

quently used in audio type oscilloscopes hitherto available employ a gas triode valve. Although the linearity of the forward trace is not always perfect, the upper repetition frequency limited to something of the order of 50 Kc/s, and the output relatively low, a gas triode time base is usually capable of a performance adequate for a television test instrument.

Multivibrator and Miller time bases employing high vacuum valves are frequently used nowadays since they are capable of extremely good performance and are little, if any, more complicated than the gas triode type. The Miller time base, particularly, can be made to deliver a high output and, therefore, in many cases, dispense with the need for the horizontal amplifier invariably used with the gas triode time base oscillator.

The limitation which makes most audio test oscilloscopes unsuitable for television work is the performance of the vertical amplifier. Around a television receiver pure waveforms are the exception rather than the rule. Complex waveforms are due to a fundamental pure wave plus a series of harmonics with a particular phase and amplitude with respect to the fundamental.

PERFORMANCE REQUIRED

In order to display the waveform existing in the receiver without distortion, a test oscilloscope must amplify all components by the same amount and not alter their relative phase.

It is difficult to give a minimum performance for an oscilloscope vertical amplifier for television receiver servicing but if pressed for an answer we would say that the response should be level up to about 1 Mc/s and taper off reasonably slowly thereafter.

A vertical amplifier with about this performance will give most of the information required and the difference between a 1 Mc/s performance and one of the usual audio type oscilloscopes will be quite obvious.

How far above 1 Mc/s it is worthwhile going is open to debate. Certainly the better the characteristics of the amplifier the nearer is the pattern on the screen to the true waveform in the receiver under test but improved performance can only be obtained at the expense of higher powered components, more complicated circuits, and so on.

For special scientific purposes oscilloscopes with a frequency response curve level to at least 10 Mc/s are not uncommon. A pair of transmitting valves are used for the final amplifier stage while a system of fans for forced air cooling may be included in the special trolley cabinet. The total weight may be several hundredweight and the cost anything from £1000 upwards.

AMPLITUDE MEASUREMENTS

However, using small readily available valves, etc., it isn't too hard to design for a response up to several Mc/s while the size and weight can be comparable with the usual audio instruments.

Apart from having a wide frequency range, therefore, a television test oscilloscope should be able to be used as a measuring device.

When dealing with a pure sine wave in high impedance circuits, the amplitude can be measured with a valve voltmeter. Most valve voltmeters are of the shunt diode type and, in fact, their reading is proportional to the peak value of the signal. They can be calibrated in rms values only where the measured waveform is pure.

VOLTMETER LIMITATIONS

If a valve voltmeter is applied to a one of the waveforms of Figure 2 the indication will be proportional to the peak value of the signal but if it is calibrated in rms valves the actual reading will not mean very much. The position is further confused by the loading effects of diode where the signal source has appreciable internal impedance. When the time the signal is at its peak value is small compared with the total time of a cycle the reading will be further in error due to discharge of the storage capacitor in the voltmeter itself.

It should be fairly clear then, that the valve voltmeter is of limited value

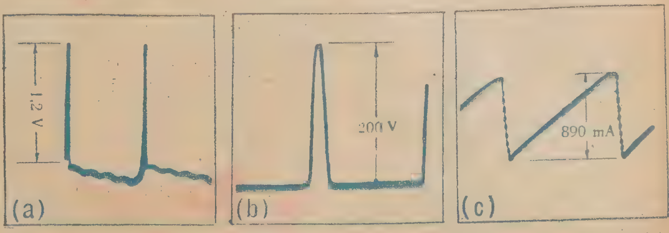

Figure 2. Waveforms are typical of those found in TV receivers (a) sync. pulse at input to frame oscillator (b) flyback pulse before differentiation and (c) current in frame deflection coil obtained by measuring voltage across small series resistor.

TV COMPONENTS

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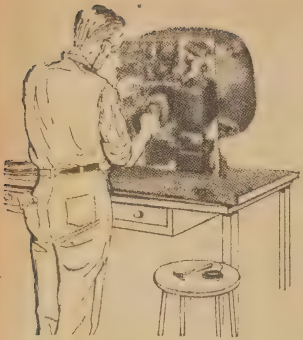
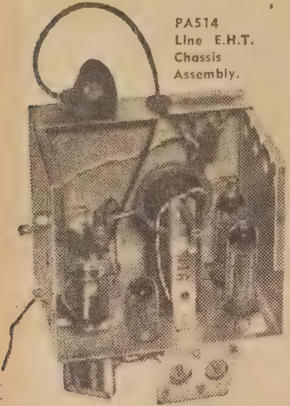
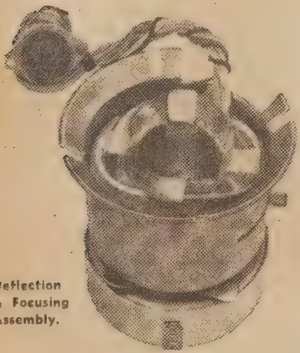
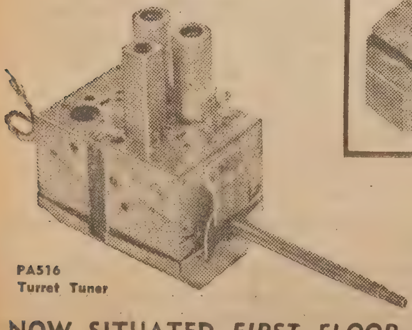


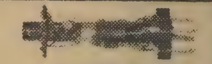

PA514 Line E.H.T. Chassis Assembly.


Deflection & Focusing Assembly.


PA516 Turret Tuner

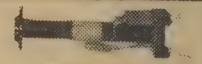
L146 Coupling Coil Yellow.

L147 Video I.F. Coupling & Trap Coil Green.


L148 Coupling Coil Blue

L149 Coupling Coil Violet

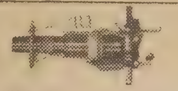
L150 Video I.F. Sound Trap Coil Orange.

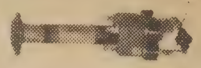

L151 2nd Video I.F. Transformer Red.

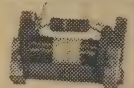
L152 1st Video I.F. Transformer Brown.

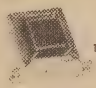
L187 1st S.S. MC/S I.F. Trans. White.

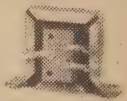
L188 S.S. MC/S I.F. Transformer Black

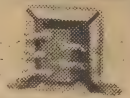

L189 F.M. Ratio Detector Transformer


L192 Video Sound Trap Coil Grey


T129 Line Linearity Coil.

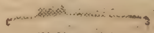

T110 Filter Choke


T125 Line Blocking Transformer


T126 Push pull Line Sync Trans

Aerial Coils: L166 Channel 2; L176 Channel 7; L180 Channel 9

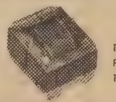
Filament Chokes: L154 Green; L155 Yellow; L156 Red.

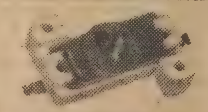

L185 Filament Choke

Mixer Coils: L167 Channel 2, L177 Channel 7; L181 Channel 9

Video Compensating Coils: L160 Yellow; L161 Red; L162 Blue.

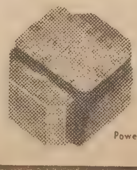
L214 Neutralising Coil


T115 Frame Output Transformer.


Trimmer Condensers, C118, C212.

A101/821 Deflection Coil Assembly.

T117 Deflection Coil.


T112 Power Transformer.

PA515 I.F. Chassis.

T116 Horizontal Output Transformer

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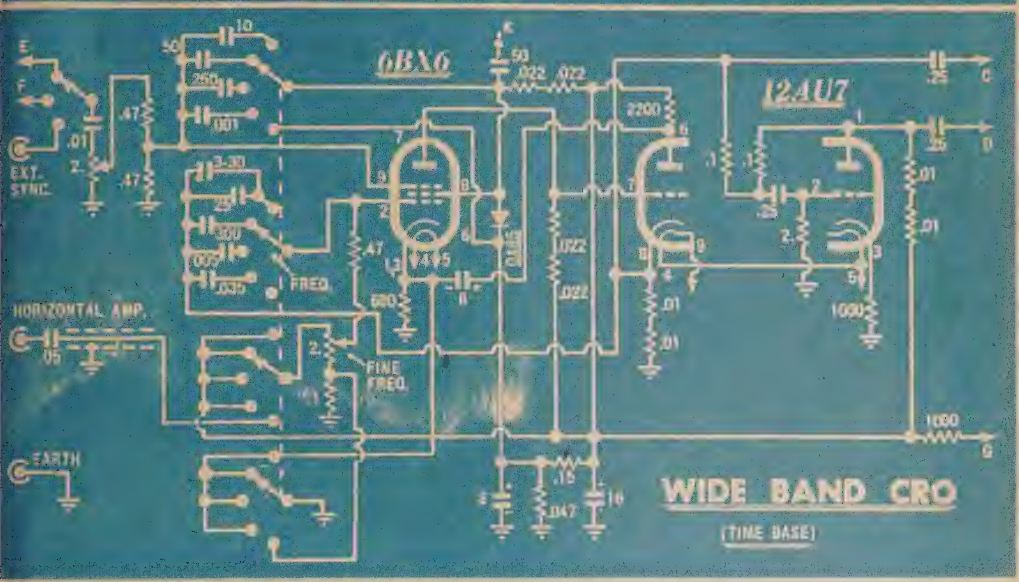

Figure 4. The 6BX6 runs as a Miller/transitron oscillator with 4 ranges covering between 10 c/s and 100 Kc/s. A fifth position switches the valve to voltage amplifier operation. The 12AU7 delivers a balanced output to the CRT deflector plates. A very simple but effective synchronising arrangement is used.

for the measurement of the amplitudes of complex waveforms in a TV receiver.

If full use is to be made of the data issued by manufacturers relating to the waveforms in their receivers, it should be possible to make quantative observations from the screen of the oscilloscope.

At this time it is not practicable to make a service oscilloscope capable of making measurements with the accuracy of a valve voltmeter nor is this necessary. If amplitude measurements with an accuracy of plus or minus 10 pc or even 20 pc are possible it is usually good enough and very much more satisfactory than guesswork based on the valve voltmeter reading.

STEPPED ATTENUATOR

A stepped attenuator is frequently used in television test oscilloscopes instead of the continuously variable control familiar in the audio instrument to allow an amplitude scale to be engraved on the graticule in front of the CRT screen. Without the horizontal sweep, a vertical line with length proportional to the peak to peak amplitude of the signal appears on the screen while a synchronised sweep allows additional waveform information to be displayed in the usual way.

In the case of a voltmeter with a meter indicator it is reasonable to make the ranges in the ratio of up to 5 to 1. However, since the CRT is not as definite an indicator as a meter and it is desired that a pattern height filling a good part of the screen be displayed, the ranges are kept to a ratio of about 2 to 1. The series 1, 2, 5, 10, etc., give approximately this ratio and at the same time allows a fairly simple scale to be engraved on the graticule.

There is a second important reason for a stepped attenuator rather than a continuously variable control. At the upper frequencies which a television test instrument must be able to handle, unavoidable stray capacitances to ground have reactances comparable with circuit resistances, so that they cannot be ignored. A stepped attenuator permits an exact adjustment for each setting.

So much for a very brief introduction to the subject.

In the design of an oscilloscope, the first item to consider is the cathode ray tube. Although it is more than 10 years since the war, disposals cathode ray tubes are still in good supply at a fraction of their original cost. Admittedly, a small percentage of the tubes now have a gas pressure above normal, due to standing, but even if you are unlucky it will cost a lot less to obtain a good CR tube from disposals than through the usual commercial channels.

Of the CRT types available from disposals sources, the 5BP1 and the VCR97 with screen diameters of 5in and 6in respectively are the most plentiful, and at the same time the most suitable. It is logical, therefore, that our new oscilloscope should be able to use either of these types.

At the same time, some of the latest tubes have more attractive characteristics than these types, and if you are prepared to spend from £10 to £15 on a

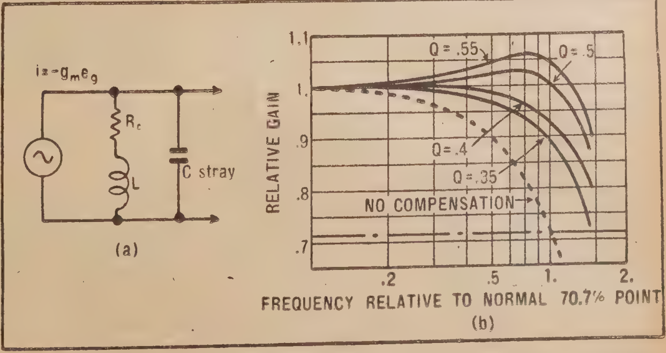

Figure 5. The effect of varying amounts of peaking inductance. For good transient performance, the response should not be allowed to rise substantially above reference level at any frequency.

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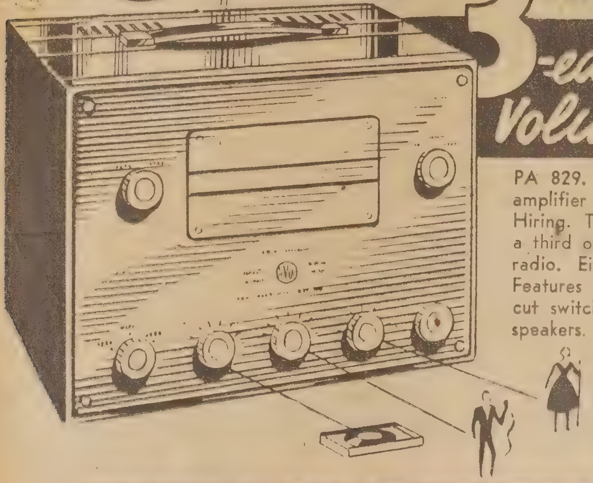

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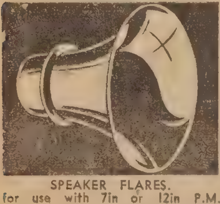

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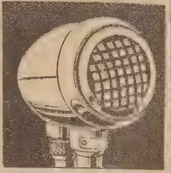

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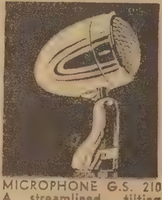

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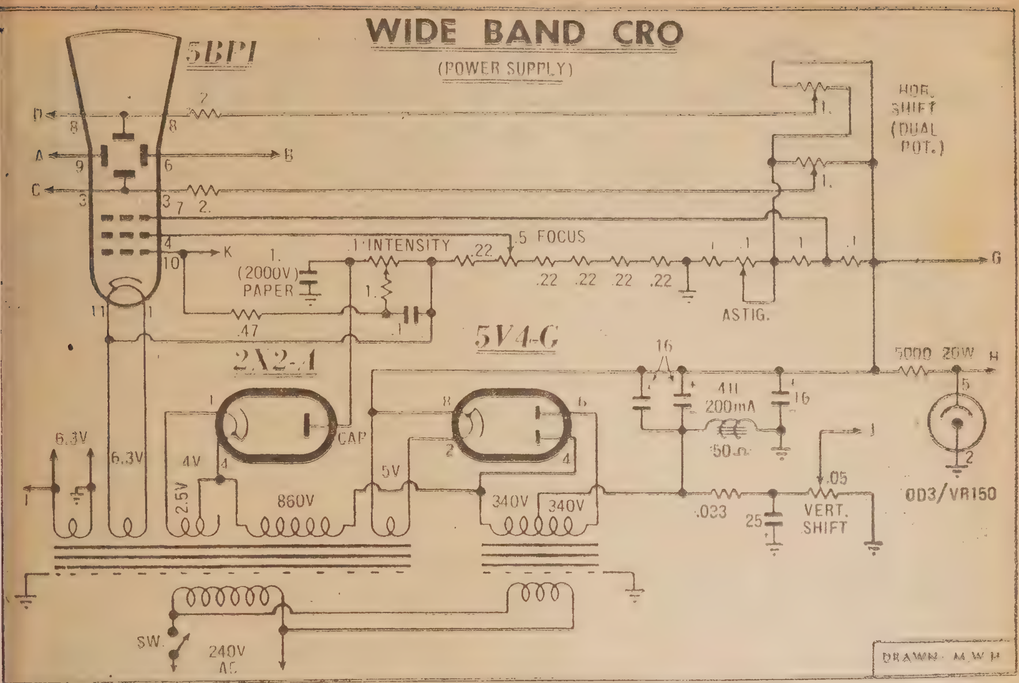

Figure 6. Power supply and control circuits. The balanced horizontal shift control requires a dual potentiometer while a control astigmatism) is provided to keep the final accelerating anode and the deflector plates at the same potential. It requires only occasional adjustment.

new tube you could have a choice of screen phosphors, better deflection sensitivity and lower stray capacitances. External dimensions are about the same or less than for the 5BP1 and the VCR97, so that an instrument designed around these will have room for the newer types.

Considerable thought was given to the mechanical design of the new instrument. We felt that some of our earlier designs, while having the advantage of a simple and inexpensive chassis, did leave a lot to be desired both in the matter of stray capacitances and ease of construction.

MECHANICAL FEATURES

Unfortunately, it is easy to admire the mechanical features of commercial instruments in glossy overseas publications, but the cost from the point of view of the home constructor would be all out of proportion to the advantages gained.

The main amplifiers and the time base of our new instrument are built in a vertical chassis at the rear of the case. Important advantages are that the critical connections between the output amplifiers and the cathode ray tube need only be a couple of inches long and that most of the components are accessible simply by removing the back of the case when minor service operations are necessary. With an instrument of this weight and bulk, this last point is very important.

If checks of components not accessible from the rear are necessary, the vertical chassis makes the assembly self-supporting in an inverted position without damage to components, again an important advantage.

The layout makes it necessary to use extension shafts for a number of controls, which, because of critical leads, must be placed in the rear chassis. Brass rod ¼in in diameter is plentiful and cheap, and there are no difficulties in making all the remote controls smooth without backlash.

Shafts for two of the controls are at a slight angle in order to allow optimum panel layout and at the same time placement of components in the rear chassis.

Valves in the main amplifier and timebase circuits are mounted horizontally, with tips toward the front panel. The types used are not critical of mounting position and the better quality noval sockets are capable of holding them firmly. Special clamping sockets may be used if desired, but not the totally enclosed type, which would hinder heat-dissipation and increase unnecessarily stray circuit capacitances.

Space on the horizontal chassis between the front panel and the vertical chassis is available for power transformers, rectifier valves and small components associated with the power supply. The pre-amplifier valve is logically placed on the horizontal chassis close to the front panel and input attenuator.

A cathode follower accepts the output from and provides a high load impedance for the pre-amplifier. At the same time, the low output impedance of the cathode follower allows it to be fed into a secondary attenuator with resistance low enough for compensation to be unnecessary.

CATHODE FOLLOWER

A long lead from the output of the cathode follower at the front of the instrument can be run to the grid of the first amplifier on the rear chassis without appreciable attenuation within the frequency range of the instrument. Further, the low internal resistance of the circuit ensures that hum pickup in the long, unshielded lead is insignificant.

High-frequency performance of oscilloscope amplifiers is limited by stray circuit capacitance. As the frequency becomes higher the reactance of stray capacitances becomes lower, and hence the attenuation in resistance/capacity coupled amplifiers greater.

AN EXAMPLE

A specific example will make the problem clearer. The input capacitance associated with the deflector plate of a typical 5in CR tube is about 15 pF. Even in the case of a specially-designed video pentode, the output capacitance will be about 7 pF., to which must be added strays of at least 5 pF., making an optimistic minimum of 27 pF., which has a reactance of 6000 ohms at 1 Mc/s and 2000 ohms at 3 Mc/s.

One of the ways of extending the upper frequency response of the amplifier is to employ low-value load resistances. The idea is that it then requires a higher frequency for the reactance of the stray capacitance to become comparable with the load resistance.

Unfortunately, as the load resistance is reduced, the gain of the stage is reduced, and also the maximum output voltage which it is capable of delivering.

Gain can be increased by employing special high gm valves, but it is not easy to manufacture such valves, and in practice the upper limit is of the order of 8 mA/V. Valves with greater gm figures are available, but on further checking it will be found that the input and output capacitances are high, making the figure of merit, or gain-bandwidth factor, less than for valves of moderate gm. In

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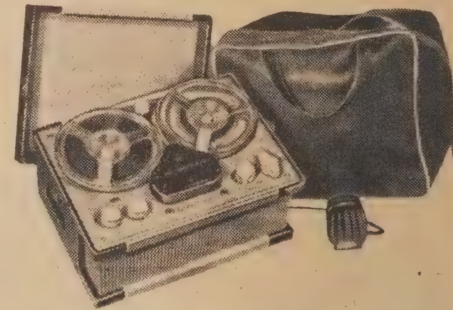

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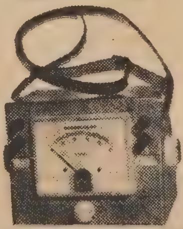

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eneral, therefore, more stages are required for a given gain in a wide-band mplifier than in a narrow-band ampli- er.

Maximum undistorted output from an mplifier with low-value load resistance an be increased by increasing the curent flowing through the load, i.e., the late current of the valve. This means hat the plate dissipation of the valve nd the power dissipated in the load esistor must be high. Some small adantage is gained by the high plate curent in that the gm increases, but the roblem of obtaining high gain, high oltage output and wide bandwidth at e same time is a serious one.

COMPROMISE

In practice it becomes a matter of riking a compromise between bandidth and maximum undistorted deflecon on the one hand and cost and comlexity on the other. The greater the andwidth the greater the power conumption and the number of valves hile in order to economise for a given equency response wideband oscillocopes are usually designed for an unistorted deflection of about the diameter f the screen only.

It is worth digressing for a moment note how the design of a wide band mplifier can be analysed on a quantitave basis. Figure 3a shows a voltage mplifier circuit and the resistance cap city coupling components in the plate ircuit.

For analysing the circuit at small sigal levels the equivalent circuit of 3b is onvenient. Here the pentode valve is eplaced by a constant current generator nd a shunt resistance equal to the dynamic plate resistance of the valve

At medium frequencies the coupling apacitance Cc normally has a low reactance while the stray capacitance has high reactance so that both capacitors an be omitted from the equivalent circuit with small error. Further, in the ase of a wide band amplifier, the coupng (or load) resistance Rc is usually mall compared with the other two and he equivalent resistance of all three in arallel is almost equal to Rc. This beng the case a simple calculation shows hat the gain of the stage is closely equal o gm times Rc.

LARGE VALUES

At low frequencies, the reactance of he stray shunt capacitance is high but he reactance of the coupling capaciance becomes appreciable. In order hat low frequencies not be attenuated Cc should be made as large as possible nd also Rgl the grid return resistance f the following valve.

At high frequencies the stray capaciance becomes appreciable and as we ave already mentioned the value of Rc s reduced in order to reduce the shuntng effect.

In the low frequency case there is a imit to the upper value of Rgl because f the characteristics of the following alve. Usually it is of from 1 to 2 negohms. Cc cannot be made too large ecause it tends to become large physi

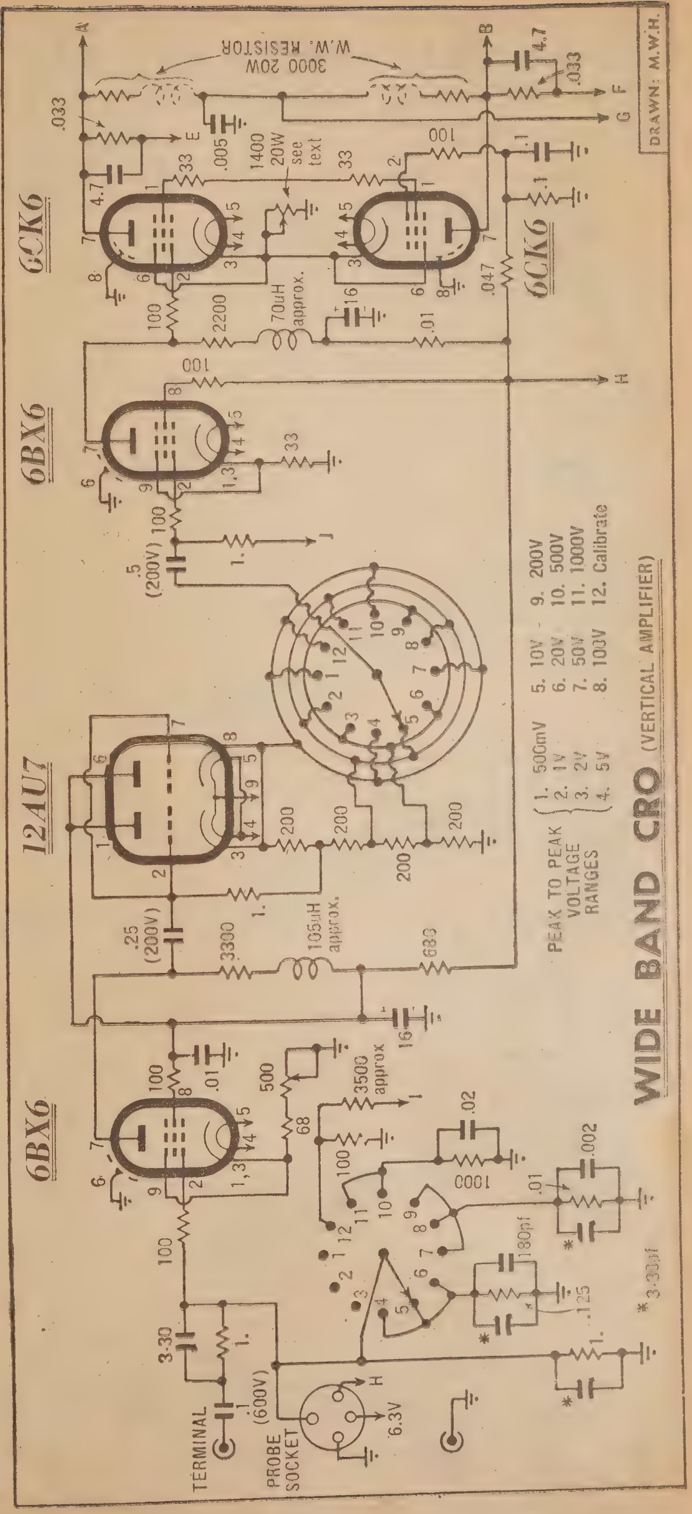

Figure 7. Vertical amplifier response is level from below 1 c/s to over 3Mc/s and undistorted output at medium frequencies sufficient to deflect the spot off the screen. Details of its adjustment will be given in a subsequent issue.

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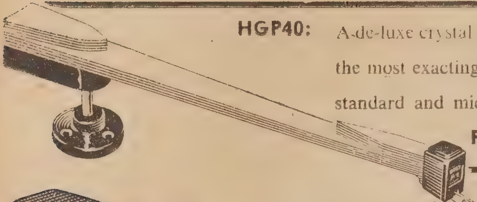

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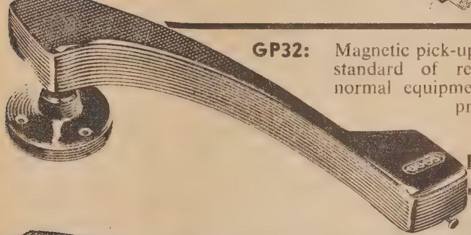

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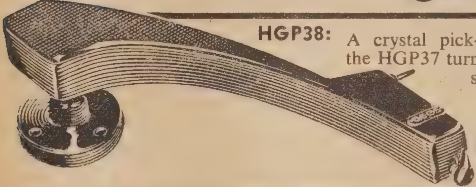

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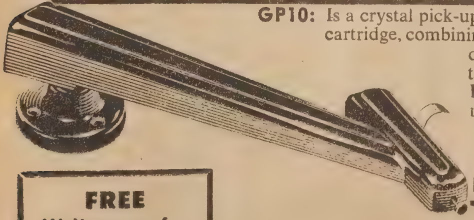

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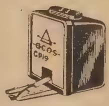

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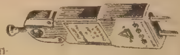

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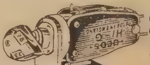

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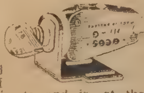

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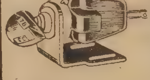

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ally. It then has a large capacitance o earth and adversely affects the high requency response.

When the largest values of Cc and Rgl which can reasonably be used are hosen it is usually found that the low requency response is still not good nough for checking certain waveforms ikely to be found in television testing. t can be further extended by placing n additional load resistance in series vith Rc and bypassing the junction to round with a large value capacitor. In he circuit diagram, the arrangement is he same as the familiar decoupling cir-uit and in fact it can and often does erve both purposes.

LOW FREQUENCIES

The upper line of the additional oad resistance is set by the permissible oltage drop while for exact compensa-ion the time constant of the additional oad resistance and the capacitor must e chosen equal to the time constant of c and Rgl. In practice, the one low requency compensating circuit can make p for low frequency attenuation in a umber of Rc coupling circuits at the ame time. It is easy to determine the ptimum values by observing the per-ormance on very low frequency square vaves.

In this instrument the low frequency alf power point is well below 1 c/s, a erformance which would be regarded t phenomenal in an audio frequency ower amplifier. It can handle a 25 c/s quare wave with negligible distortion.

At high frequencies the upper half ower frequency can be extended by a actor of about 1.5 to 1 by placing an inductance of suitable value in series with Rc. If Q is defined as the ratio of the reactance of the series inductor at the half power frequency without compensation to the value of the load resistance, then the performance of the amplifier with different values of peaking inductance is shown in Figure 3.

In practice, the value of the peaking inductance is not extremely critical, but if it is made too high there will be a peak within the range and the amplifier will tend to overshoot on transients. On the other hand, if it is too low the amplitude will tend to drop off at a lower frequency than with the correct value.

PEAKING METHODS

The method of Figure 5 is known as shunt peaking. There is also a series compensating method, which is capable of extending the upper frequency range even further, but it has the disadvantage of being more critical to adjust correctly than the simple shunt method. At the same time it may well be worth while describing a version of the vertical amplifier with series peaking at a later date for those who are willing to tackle the more involved and critical adjustment procedure.

Low frequency attenuation due to coupling components can be completely overcome by using direct coupling. This method also helps to improve the position at high frequencies since the stray capacitance between the coupling capacitor and ground no longer exists.

Amplifiers direct coupled from the input terminals to the CR tube deflector plated can and have been designed. However, such amplifiers introduce fairly serious problems in the matter of power supplies, attenuators and stability.

Our new oscilloscope uses direct coupling between the output valves and the CRT deflector plates and also between the driver and push-pull output stage. Three coupling capacitors which would normally be required to have a large value and voltage rating are eliminated, while the circuit is complicated only by the need for an astigmatism control. The latter is required to keep the final accelerating anode of the CR tube at the average potential of the plates of the output valves and thus avoid defocusing.

From a study of the circuit (Figure 6) you may note also that a balanced horizontal shift control has been included for the same reason.

A balanced shift in a vertical direction is automatically obtained when the shift bias is applied to the grid of the driver valve.

Coupling capacitors between the preamplifier and cathode follower (Figure 7) and also between the cathode follower and the driver are not subjected to a high DC voltage and, therefore, may be physically small. Stray capacitance to earth is then not so serious a problem.

The capacitance between the input terminal must have a high voltage rating and a fairly high value is required. The physically large component effectively increases the input capacitance of the instrument. In cases where the source impedance of the circuit being measured is high a special probe is the best solution and provision for a probe is, therefore, made.

PERFORMANCE FIGURES

The high frequency half power point of the new instrument is above 3 Mc/s. Further details will be given later when we describe the construction and adjustment.

Energy fed into the wideband amplifiers eventually appears in the form of heat and it is very necessary to design a wideband oscilloscope in such a way that the heat can be dissipated without excessive temperature rise. The main heat-producing components are valves, high power resistors and transformers and the mechanical arrangements should be such that the flow of air by convection around these components is restricted as little as possible.

The extensive cut-outs in the cabinet and chassis of the new oscilloscope as detailed in the full-size blueprints are essential for normal component life.

Electrolytic capacitors deteriorate rapidly if subjected to excessive temperatures, while wax-impregnated paper capacitors, resistors, transformers and all other components will suffer if ventilation is not provided.

Some of the newer paper capacitors are specially designed to withstand elevated temperatures and the position now in this regard is better than it was a few years ago.

The electron beam of a cathode ray tube is sensitive to magnetic as well as electric fields, which creates another problem in the design of a cathode ray oscilloscope. Large power transformers are required for a wideband CRO and even when they are specially designed there will be some external magnetic field to cause spurious deflection of the spot.

In order to keep the external magnetic field from the transformer as low as possible high permiability iron is used and the core made as large as possible. Compromises have to be made because of cost and size, while in many cases weight will be a consideration.

A heavy copper band wrapped around the outside of the transformer serves as a simple and inexpensive means of reducing the external field and the transformer types we have specified for the new instrument are fitted with this band.

Yet another means of reducing the external field is to totally enclose the transformer in a magnetic shield made from, say, cast iron. Such a shield is bulky and introduces difficulties in bringing out the leads.

MAGNETIC SHIELDING

It is generally cheaper and more satisfactory to leave the precautions at the transformer end to a low flux design plus a copper band and concentrate on shielding the cathode ray tube itself.

It is unfortunate that the shields provided for the tubes in the original military equipment are not very satisfactory where power transformers of the size required for a wideband CRO are to be included in the same case as the CR tube. In any case the original shields appear to be in very short supply.

While it is possible to buy special mu-metal shields covering the full length of the tube and providing very effective shielding, such shields are expensive and must be ordered specially. The delivery delay may be some months.

For many people a special mu metal shield will not be an acceptable solution to the problem and we, therefore, hope to be able to give the specifications of a shield which can be made from more readily available materials in an early issue.

We must point out that the problem of magnetic deflection is simply a result of designing a compact wide band instrument and that designers of commercial instruments face exactly the same problems. In fact, by using two power transformers as we have done and phasing the primaries suitably, the magnetic fields can be made to partially cancel out and the spurious deflection is reasonably small. Also, the beam accelerating voltage is fairly high at almost 2 KV, which helps to make it insensitive to stray magnetic fields.

The high EHT also helps to produce a fine focus but, quite apart from the tube ratings, there is a limit to the desirable EHT because the voltage required to deflect the beam becomes proportionately higher.

FILTER CHOKE

The magnetic field from the filter choke can also have an appreciable effect on the electron beam and its placement was carefully considered in the new instrument. The most satisfactory position is directly under the CR tube on the vertical chassis where it is easy to provide a greater thickness of shielding material.

The alternating component of the magnetic field from the filter choke can be reduced by using a high value for the input filter capacitor. Care must be taken that the peak current rating of the rectifier valve is not exceeded, however.

We mention all these problems in order that readers appreciate them fully but in practice the most rudimentary shielding will reduce the spurious deflection to the point where the instrument can be put to use satisfactorily. It is only when the extremely fine trace which the electrical circuit permits is required that all precautions need be taken.

(To be Continued)

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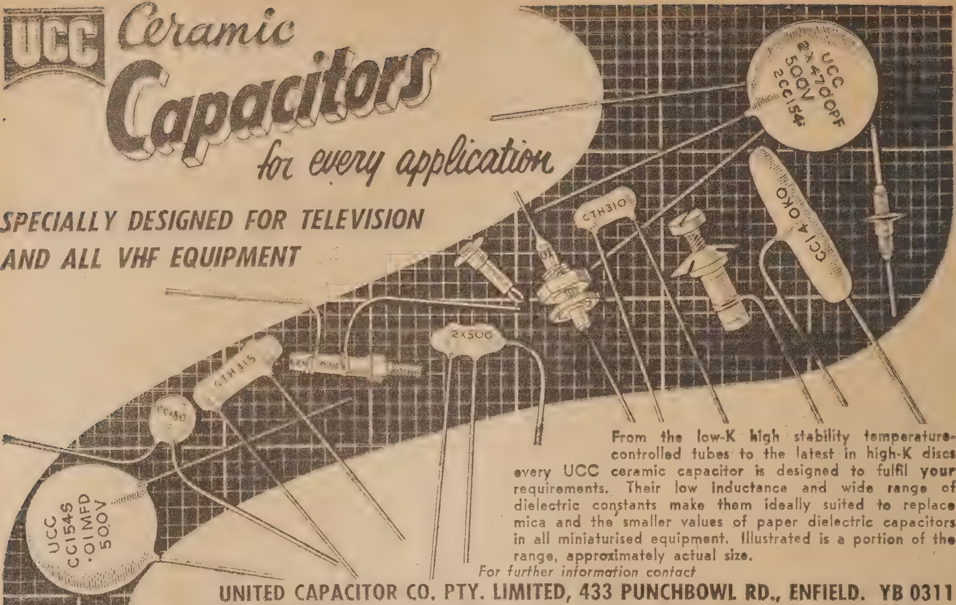

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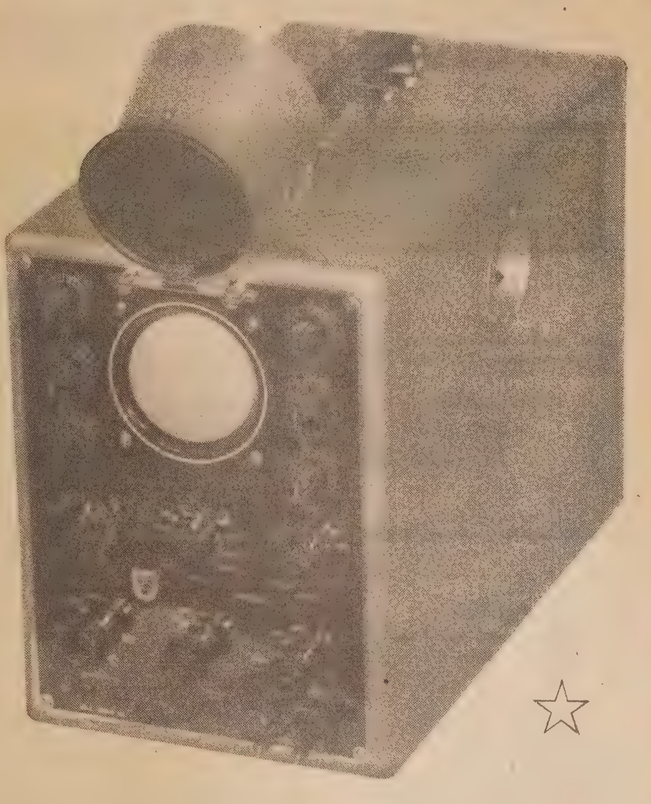
TRADE REVIEWS AND RELEASES

An instrument recently submitted to our laboratory for examination was the Philips cathode ray oscillate type GM5659. This is one of a series of instruments this firm is currently making available for TV servicing.



The Philips GM5659 cathode ray oscilloscope reviewed on this page. The screen hood and green filter-graticule are shown folded back in this picture. Either or both may be swung in front of the screen as required.

A PRODUCT of the Dutch Philips factory; The GM5659 reflects the esources of a large organisation with wide experience in the manufacture of ll types of electronic equipment. The mall fittings are numerous and immaculately finished.

A very worthwhile feature is a hinged ood which can be swung in front of he screen to minimise external light eflections. This, in conjunction with a eep green filter, makes for easy observation under the brightest lighting conditions. The green filter also carries graticule to facilitate measurement of observed phenomena.

The case measures 12in high, 8¾in wide, and 16in deep; these dimensions nclude the carrying handle and knobs. The case is well ventilated with attractive grille sections, while the internal ayout has been very carefully planned to allow a free flow of air past the major heat producing components.

Shock mounting feet make the instrument suitable for mounting in a truck or other situation likely to be subject to vibration.

BANDWIDTH 1Mc

Electrically also, the GM5659 is a very attractive instrument. Both the horizontal and vertical amplifiers have he same specifications which include an amplification of 850 times and a bandwidth from 1 cps to 1 Mc.

This bandwidth is adequate to allow observation of the pulse shaped and rectangular voltages normally encountered in TV receivers with at least sufficient accuracy for service work. For design work a more elaborate instrument may be justified.

Another feature of considerable value n TV servicing is the provision of calibrated gain controls whereby the instrument may be used as a voltmeter of reasonable accuracy. By reason of the wave forms encountered in TV receivers it is seldom that a conventional VTVM is able to give an accurate reading. In order to make full use of the data provided by set manufacturers it appears essential to use a calibrated CRO.

Facilities for external intensity modulation of the beam are provided, a feature which will be found useful in many applications, including fly-back suppression when used with certain types of wobbulators.

In practice, the gain of the deflection amplifiers provides a very useful margin over normal requirements, meaning that even abnormally weak signals can be portrayed effectively.

The time base is of the hard valve variety, employing two twin triodes. Three of the triodes generate the actual saw tooth voltage while the fourth acts as a synchronising tube to trigger the time base.

The result is a time base having excellent linearity and convenient synchronising facilities. There is no adjustable synchronising control as in older style instruments, merely a switch to select various arrangements of internal or external control. Synchronising is virtually automatic and without any undesirable distortion of the image.

ON TEST

Used in our own laboratory over a period of several days this instrument lived up to all the manufacturer's claims for it. The controls are smooth mechanically and positive in action electrically; free from interlocking and drift effects, while there is adequate access to the various internal functions.

A study of the schematic circuit diagram makes it obvious that the GM5659 is the result of considerable developmental work directed toward obtaining an instrument that is smooth and easy to control.

For example, the vertical amplifier is push-pull throughout which allows a vernier gain control to be included while both the frequency response of the amplifier and the positon of the pattern are independent of its setting.

A system of negative feedback with two separate feedback paths assists in obtaining the stability and good frequency characteristics which are a feature of the oscilloscope.

All in all, we found it a very nice instrument to handle and one which, for the TV and radio serviceman, would be very hard to fault.

The price is £156 (plus sales tax where applicable) and further details may be obtained from Philips Electrical Industries Pty. Ltd., 69 Clarence St., Sydney.

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[illegible]

All About Batteries

(Continued from page 51)

xactly 2.0 volts. There it remains for long period, falling to 1.8 volts at ery low charge.

Generally speaking a battery should ot be used when the voltage per cell less than 1.8, or when the specific ravity is less than about 1110. Failure o observe this requirement may result n permanent damage to the plates.

The current capacity of an accumuator is summed up in its AMPERE-IOUR rating, which gives a rough idea f the number of hours it will continue, fter a full charge, to deliver a specified mount of current.

The rate at which an accumulator is lischarged does not appear to be imortant, as far as the life of the batery is concerned. It has even been laimed that an accumulator can be hort-circuited without damage to the lates or the active materials.

The same is not true of charging, hough this is frequently the subject of lebate. Other than in exceptional cirumstances it does not appear wise to e-charge an accumulator at a rate reater than that specified by the manuacturers.

Charging at an excessive rate or at high rate for prolonged periods can ause internal heating and violent gasing, possibly distorting the plates and lislodging active material from them.

When not in actual use, an accumulator vill gradually discharge through its wn internal losses, the effect increasing is the battery ages.

To offset this and prevent sulphation of the plates, an idle battery should be iven a small charge every couple of veeks and its condition checked periodcally with a hydrometer.

When the electrolyte evaporates sufficiently to uncover the tops of the plates, it should be brought back to its normal level by the addition of pure, distilled water.

Let's Buy an Argument

(Continued from Page 45)

Would it be a desirable state of affairs anyway?

Lacking the time just now to investigate the matter, I can't say for certain but I'd rather expect a negative answer to both questions. This would invalidate G.T.'s arguments, assuming that I've correctly interpreted his ideas.

Another point has me thoroughly puzzled. How could any malfunctioning of the frame oscillator give sequential scanning as distinct from pairing?

Sequential scanning would simply mean that line 2 would follow immediately on line 1; then lines 3, 4, 5 and so on.

But this can't happen, because the transmitter doesn't send out line 2 until a fiftieth of a second after line 1. What about all the other lines in between?

No, G.T. The nature of the scanning is determined at the transmitter. Short of a memory system, the receiver can't present the lines in any order but the one in which they are sent out. All it can do is to jumble them together or break the picture into segments.

As far as I can see, the mystery of the post-equalising pulses remains unsolved.

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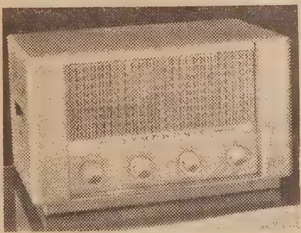

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A COURSE IN TELEVISION

Having discussed IF amplifiers and intercarrier sound channels, the next logical step is an examination of the video detector circuit itself. As we shall see, it is intimately bound up with the design of the preceding IF amplifier stage, the following video stage and the method of feed to the picture tube.

PART SEVENTEEN

THE picture carrier from a television station is amplitude modulated and the function of the video detector circuit is basically similar to the detector in an ordinary AM broadcast receiver. I must resolve the modulation component from the carrier (or IF resultant) and its related sidebands, suppressing the now unwanted carrier components and passing the modulation on to the video circuits for ultimate application to the picture tube.

Basically, therefore, it becomes feasible to use any of the commonly-known AM detectors—grid-leak, anode bend, reflex, diode, triode, pentode, &c.—and, in fact, most of them have appeared at one time or another in overseas television receivers.

Nowadays, however, it is almost universal practice to use diodes, either valve or crystal, in half-wave detector circuits and an examination of other types is hardly warranted at this stage. The almost universal use of diodes is in line with modern practice in AM broadcast receivers.

BASIC DETECTOR

Figure 109 shows a basic half-wave diode detector, having a source of signal input and a load resistor "R" across which the detector develops a voltage corresponding to the original modulation. (It is assumed that the reader will not need a detailed explanation of detector action.)

The capacitor "C" across the load resistor is an essential part of the circuit. It acts as a storage capacitor to maintain the potential across "R" during that part of each RF input cycle when the diode is not conducting.

At the same time it serves as an RF bypass to attenuate the carrier components, preventing them from penetrating succeeding amplifier circuits and possibly causing instability, overload or other undesirable effects.

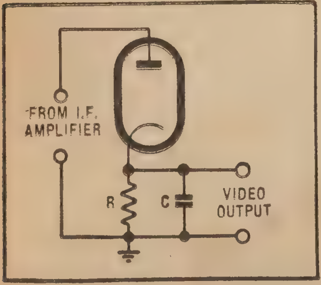

Figure 109 A basic diode detector circuit, giving positive output with increasing carrier amplitude. The function of "R" and "C" is discussed in the text.

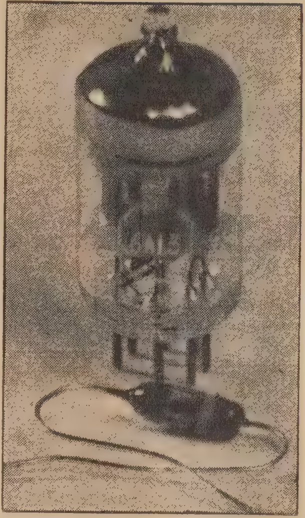

Figure 110. Two commonly used video detectors. At the rear, the 6AL5 low-perveance twin diode; at the front, the OA70 germanium diode expressly intended for video detection.

The value of "C" is dependant to a large degree on the choice of "R". Its capacitative reactance should be very much less than the resistance of "R" at the incoming signal frequency, so that these components will be bypassed to ground instead of appearing as a substantial voltage across "R".

TIME CONSTANT

Alternatively, it might be said that "R" and "C" must have a time constant which is long compared with the time interval of one RF input cycle.

Against this, the time constant of the combination must not be made comparable with one cycle of the highest modulating frequency. If this were the case, a proportion of the higher frequency modulation content would be bypassed to ground along with the RF (or IF) component.

In an AM broadcast receiver the load resistor "R" normally has a value of between 0.1 and 0.5 megohms, being determined by such things as detector efficiency, the impedance of typical diode detectors, the permissible loading on associated tuned circuits, the shunting effects of succeeding audio coupling circuits and possible loss of higher modulating frequencies due to shunt capacitive loading.

It is not very difficult to choose a suitable value for "C" in a conventional AM broadcast receiver, because the incoming frequency (usually 455 Kc.) is from 30 to 60 times greater than the maximum audio modulation frequency which the designer may choose to preserve.

Capacitor "C" may typically have a value of 100pf. This represents a reactance of about 3500 ohms at 455Kc, and would therefore constitute a fairly effective RF bypass. At 15Kc, the highest likely modulation frequency, the reactance is greater than 0.1 meg, so that the shunting effect on the load is only just becoming appreciable.

BYPASSING EFFECT

At frequencies around 5Kc to 7Kc, representing the upper response limit of most receivers, the bypassing effect of the suggested "C" is of little consequence. This remark still holds, even in cases where the designer may choose to employ two RF bypasses and a decoupling capacitor for more complete filtering ahead of the audio amplifier system.

In television video detector circuits, the position is quite different. The incoming intermediate frequency lies within the range 30-36Mc, while modulation frequencies may approach 5Mc.

In fact, in most modern receivers, the video detector must be able to produce in its output an intercarrier beat at 5.5Mc, along with the normal picture modulation, extending to almost this limit.

If the detector load "R" were to be maintained in the 0.1 to 0.5 meg. region, "C" would need to be kept down to about 1 pf. so as not to shunt the load unduly at the highest modulation frequency or at the intercarrier beat frequency.

Such a requirement would be fantastic, because stray circuit capacitances alone would amount to many times this minimum figure.

In fact, on this basis, the problem would no longer be one of nominating a suitable value for "C" but of avoiding the bypassing effects of already existing circuit capacitance.

Since there is a practical limit below which stray circuit capacitance cannot be reduced, the only course is to accept the inevitable and assume a likely figure for it.

The diode load resistance can then be reduced to a figure which is comparable with the anticipated capacitive reactance and which gives the time-constant characteristics already outlined.

Allowance may have to be made at the same time for any additional RF bypass or filter components, which may be deemed necessary.

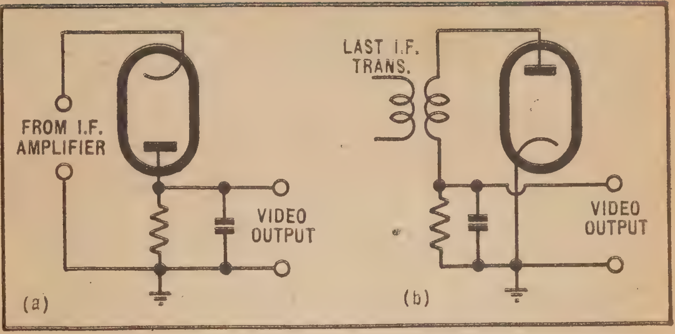

Figure 111: The polarity of a video detector must be correlated with the number of video stages and the picture-tube input to ensure that the latter produces the correct image and not a "negative". These arrangements give negative output with increasing carrier amplitude.

DIODE LOAD VALUE

In practice, this generally means the use of a diode load resistor of between 4000 and 10,000 ohms. As we shall see later, in more detail, the practice of reducing load values to counter the effect of shunt capacitance is common in circuits handling video frequencies.

The capacitor "C" is usually made about 10pf, a figure which will be discussed later in the article.

Although the choice of a low value for the diode load avoids one difficulty, it leads to others.

One rather obvious problem is that a low value of load resistance may approach the internal resistance of typical diode elements. A smaller proportion of the rectified voltage appears across the output load "R" and detector efficiency tends to fall away markedly.

To minimise the loss, detectors intended for video service are normally designed with a much lower internal impedance than the usual diode elements found in AM broadcast receivers.

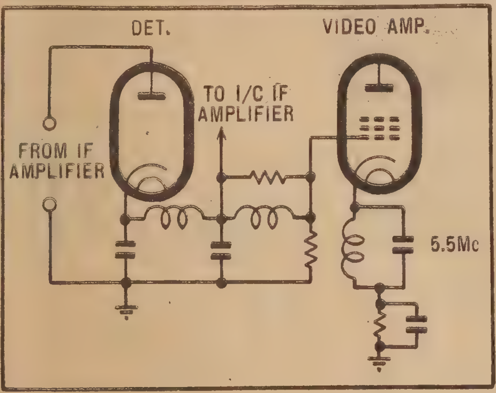

Figure 113: The detector coupling circuit provides RF filtering and video peaking, as in figure 112 (c). A resonant circuit in the video amplifier cathode return causes degeneration and limited response to the intercarrier beat frequency.

In achieving the required low impedance, manufacturers must nevertheless be careful to maintain a minimum figure of capacitance across the diode.

If appreciable capacitance is envisaged across a diode rectifier, as in figure 109, a proportion of the RF energy will be fed into the load resistor "R" by simple capacitive coupling rather than through the rectifying action of the diode.

Perhaps the best known of the currently available video detectors is the 6AL5 twin diode. This is described in technical literature as a "high-perveance" type, meaning substantially the same thing as low internal resistance.

Of miniature, 7-pin, all-glass construction, the 6AL5 exhibits a capacitance of only 2.5pf from either plate to other electrodes, and 3.4pf from either cathode to other electrodes. At the same time its internal impedance is lower than the 6H6 and very much lower than the diode elements in conventional duo-diode-amplifier valves.

In television receivers only one of the diodes is normally used for video detection, the other diode element often serving some entirely different function in the circuit. This is possible because the two diode elements are well separated and shielded, and separate connections are brought out to plates and cathodes.

As an alternative to the 6AL5, some designers prefer a germanium diode in the role of video detector, on the grounds that it is smaller, more durable and requires no socket or heater supply.

Against this, it cannot be advertised as a valve (if this is important nowadays) and is much less tolerant of electrical overload. Its characteristics also are less predictable than those of a thermionic type.

DIODE CHARACTERISTICS

The OA70 is typical of the germanium diodes which are available locally for video detector service. Characteristics indicate that it has a lower internal resistance than the 6AL5 thermionic diode and a capacitance of only 1pf, so that it is superior to the 6AL5 in these respects.

The use of low impedance diode and a low resistance load means normally that heavier damping is imposed on the signal input circuit and ultimately on the last video IF amplifier.

As we have already noted in connection with IF amplifiers (part 14) this must be considered when allocating resonance points and permissible "Q" figures to tuned circuits in the IF system.

In the particular system used as an illustration (part 14) one of the circuits in a staggered quadruple, needing to exhibit a low "Q", was deliberately

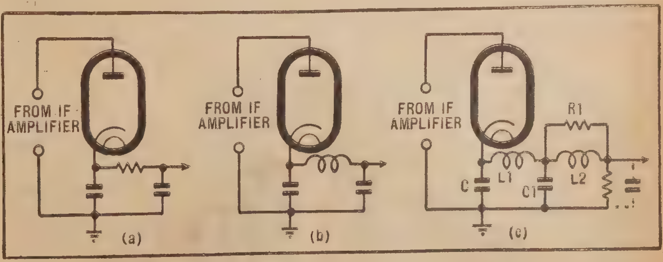

Figure 112: Illustrating diode output filter circuits. (a) is a simple resistance filter; (b) an inductive filter, which may have special characteristics by reason of resonance effects; (c) as for the previous circuit but providing for video peaking by reason of L2 and distributed capacitance.

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placed between the last IF amplifier and the detector. The heavy damping of this latter was therefore turned to good purpose.

It may also be recalled that preference was given in this position to the low-Q circuit resonating nearest the picture carrier resultant. This was to ensure that the most favorable load conditions were presented to the last IF amplifier when handling high amplitude signals adjacent to the picture carrier.

Over and above matters of circuit "Q" and frequency, the question of detector linearity must also be considered in a precise design.

In effect, the final IF amplifier is delivering power into a load which is dependant in part on the characteristics of the diode. Should the diode characteristics be non-linear over the input cycle, then some non-linearity must be evident in the detector output, both as a direct result of the detector's characteristics and also of the varying load presented to the IF amplifier.

NEED FOR LINEARITY

This factor should ideally be considered over and above the simple concept of damping and circuit "Q" as already mentioned. It may lead a designer to prefer more initial damping or a higher-capacitance input circuit than might otherwise be the case; or yet again, the use of a double-wound transformer rather than a simple tuned coupling coil.

This would apply particularly to germanium diodes, which are subject to greater spread in their characteristics than thermionic types.

Figure 110 shows a typical set of curves for the OA70 diode, issued for the guidance of designers. They indicate detector efficiency (upper curves) against input signal amplitude for varying load values, and damping resistance (lower curves) against input signal amplitude for the same range of loads.

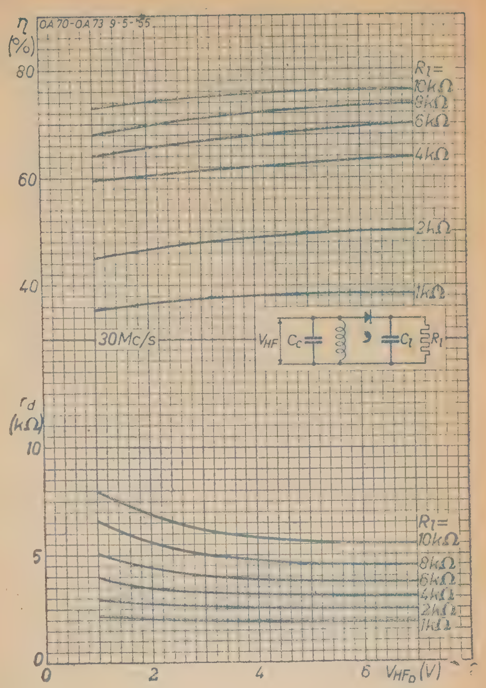

Figure 110: This typical set of curves for the OA70 germanium diode indicates its efficiency (top) and its damping resistance (bottom) plotted against input voltage and for varying values of load resistance. These curves were taken at 30Mc and differ in detail from similar curves taken at higher or lower frequencies.

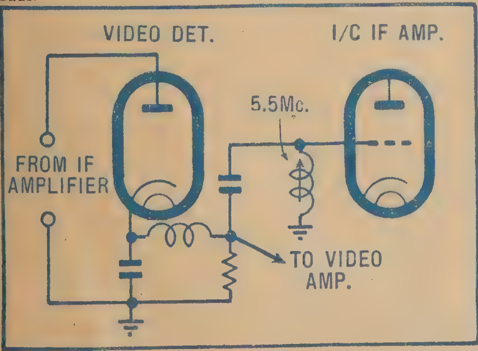

Figure 114: An alternative trap system for the intercarrier beat. A series-resonant circuit loads the detector at 5.5Mc but, at the same time, feeds maximum voltage to the first valve in the intercarrier IF amplifier.

The curves shown are for an input frequency of 30Mc and differ in detail from equivalent curves taken at higher or lower frequencies.

Just how seriously such curves are taken in the design of commercial receivers is a debatable point. It has often been suggested that the eye is not nearly so critical of non-linear distortion as the ear.

Whereas quite small degrees of non-linearity produce unpleasant distortion and intermodulation effects in an audio system, the result visually is a slight distortion in the black-to-white tone range, which the eye may not even notice.

Non-linear distortion in the video detector is not—or should not be—apparent in the sound channel because the FM sound system rejects AM characteristics.

It is not proposed to examine this matter in greater detail here. Sufficient has been said, however, to indicate the general relationship between a detector's input characteristics and the circuit which feeds signal to it.

In an AM broadcast receiver, the polarity of a diode detector is not important as far as the rectified signal is concerned. Audio waveforms impressed on the incoming carrier are quite symmetrical and the output sounds the same to the ear, irrespective of which way round in the circuit the detector is connected.

Only because of the AVC circuit, is it conventional to have the diode develop across its load a negative voltage with respect to earth.

Television signals are not symmetrical, however, peaks and troughs in the carrier amplitude indicating quite independent degrees of light and shade, according to the adopted transmission standards.

With negative modulation, as in Australia, a rise in carrier amplitude indicates an approach to the black level, while a trough corresponds to white.

In figure 109, a rise in carrier amplitude corresponding to black would thus produce an increase in positive voltage across the load resistor "R". Reduced carrier amplitude, representing white, would give reduced positive voltage.

In a general sense, therefore, it might be said that black would produce a positive-going signal and white a negative-going signal from figure 109.

PHASE INVERSION

If this video signal is passed through a single amplifier stage, the phase will naturally be inverted through 180 degrees. Black will thus produce a negative-going signal and white a positive-going signal.

This is suitable for application to the grid of the picture tube, since a negative-going signal is necessary to cut off the beam and produce black. Conversely, a positive-going signal will allow the beam to achieve greater intensity and produce a highlight.

However, if conditions were such that two video stages were necessary in a receiver, difficulty would immediately arise from the fact that a further 180-degree phase rotation would put the signal the wrong way around again.

"Black" signals would produce highlights and "white" signals a shadow, so that the ultimate image would be

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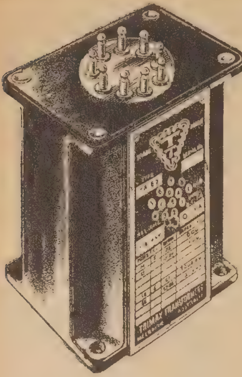

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This position could be corrected, in turn, by feeding the signal to the cathode of the picture tube rather than to the grid. Thus a "black" signal, producing a positive-going voltage, would carry the grid positive. This is equivalent to making the grid negative, so that the beam intensity would be reduced, as required.

Similarly a negative-going "white" signal, applied to the cathode, would increase beam current and produce the necessary highlight.

For reasons which will be explained later, the idea of feeding video signals to the picture tube cathode has certain advantages and is frequently adopted.

If a designer wishes to do this and still use only one video amplifier stage, then the signal phase must be reversed at the detector by wiring the detector into circuit in reverse polarity.

In the case of a germanium diode, this simply means turning it end-for-end. With a thermionic diode one or other of the arrangements shown in figure 111 would be adopted, normally 111 (a). Since the input capacitance figures to plate and cathode are not very different, this need not lead to any special difficulties.

The foregoing references to positive and negative-going signals may be a little confusing at first reading, but the basic idea should be apparent. It should indicate clearly enough the essential relationship between detector polarity, the number of video amplifier stages and the method of signal application to the picture tube.

VIDEO FILTER

By way of conclusion to this present article, further reference must be made to the capacitor "C" in figure 109 and allied provisions to filter the video signal from unwanted carrier components at the output of the detector.

The ideal situation would be one where the carrier (or intermediate resultant) frequency and the highest modulation frequency were so far apart that a simple bypass capacitor could eliminate one without markedly affecting the magnitude of the other.

As mentioned earlier, this is far from being the case, in a television receiver, because the modulation and intercarrier beat components run up to 5.5Mc. The IF lies in the region 30-36Mc, so that the ratio between the two is less than 6:1.

This means that the choice of the bypass "C" must be very much of a compromise.

If it is made large enough to give a long time constant compared with each RF input cycle, the higher modulation frequencies are unduly attenuated. If the capacitance is reduced to avoid this loss, the storage effect at the signal frequency diminishes and detector efficiency falls away.

The figure of 10pf suggested earlier, in association with stray capacitance and a 5000 to 10,000 ohm load, affords reasonable detector efficiency, but causes some loss of the higher modulation content without, however, eliminating the unwanted RF component.

Additional RF filtering and video compensation is often deemed desirable as a result, the two functions being inter-related in many cases.

Figures 112 (a) and 112 (b) show typical two-stage filter networks, intended primarily to suppress the RF component from the detector's output.

A severe resistance-capacitance filter might appeal in a small-screen receiver, where loss of high frequency modulation content may not be very significant.

The choke-capacitance filter is more complex electrically and would normally be designed to have a special pass-band characteristic, governed by the choice of capacitors, the choke inductance and the stray capacitance across the choke.

FILTER DESIGN

By way of example, it is quite possible to create a hump and a sharp roll-off in the upper video spectrum by controlling the series resonance between the choke and the terminating capacitor.

Figure 112 (c) combines the concept of RF filtering with video peaking.

The components C, C1, and L1 provide an effective RF filter, but, in so doing, discriminate rather seriously against the highest video frequencies.

This loss is countered by incorporating a further inductor L2, which is deliberately made series-resonant in the upper video range with the stray input capacitance of the following stage. This tends to create a peak in the vicinity of resonance, which is subsequently limited to about reference level by the damping resistor R1.

In the case of a split-sound receiver, the filter is simply arranged to cut off below the frequency of the intercarrier beat and little further suppression is required.

In an intercarrier receiver, the beat must be preserved for diversion to the intercarrier IF amplifier. At the same time it must be prevented from reaching the picture tube grid, otherwise it may produce a fine interference pattern as a background to the picture.

Some form of resonant trap circuit must therefore be included.

In pracice, it often becomes rather difficult to include an RF filter, a video peaking coil and an intercarrier trap, all in the detector output circuit, because of mutual interaction.

One popular scheme is illustrated in figure 113. Here the RF filter and video peaking circuits are exactly as illustrated in figure 112 (c), so that all video frequencies up to and including the inter-

(Continued on page 105)

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OFF THE RECORD — NEWS & REVIEWS

Russian Orchestras are not vey well repesented in the lists of current releases and no doubt record lovers must have often wondered how they would compare with the best we know. Now that Philips have issued a number of DGG recordings of the Leningrad Philharmonic they need wonder no longer.

by John Moyle

JUDGING by the samples I have heard this month, this orchestra will provide some stimulating and severe competition.

As we might expect from what is probably one of Russia's most important groups, it sounds a big orchestra, not merely in size but in the quality of the sound it produces.

DGG records have always gone for this big atmosphere, invariably using halls which exhibit more reverberation than is now normally allowed with English and American orchestras.

CHARACTERISTIC

In fact this is a characteristic which we can see with most European discs, and may have something to do with the fact that the hi-fi cult which demands almost constant mike placing for all instruments has not exhibited itself so strongly there.

At the other end of the scale we would probably stand the American efforts, many of which are designed, I am sure, to startle the operators of very loud and brilliant reproducers rather than to produce music, if I can allow myself such a sweeping generalisation.

But I do think that in Europe good quality radiograms are used for record playing very much more than the special equipment produced so freely in England and America.

Records such as the DGG, and Philips, too, would probably sound better under these circumstances than would those of Capitol and Mercury, which virtually demand more elaborate sound channels.

I am not suggesting this is a bad thing—quite the reverse. It is probably true that there is some kind of an optimum acoustics for recording which might be considered a standard for the best results, if we could ever decide among ourselves what the best results might be. It is most unlikely that we ever will, however, and it is the often very subtle differences between one record and another which makes listening to various versions most interesting.

For instance, I now have five different recordings of the Tchaikowsky Fourth, one of the Leningrad's efforts mentioned below, and after spending a couple of hours comparing sections of them when assessing this new release, I have to admit that the margin between them in many instances is very small.

It is often possible to be justifiably dogmatic about points which are not reasonably arguable, such as surface noise, exaggerations in tempo and bad balance, but sooner or later we come into the realm of personal preference for which a good case can be made either way.

FINE ORCHESTRA

My assessment of the Leningrad orchestra is that it is quite comparable with the top notchers we all know, and I would not choose any performances as being superior to the two reviewed here.

Compared with the Philharmonia, made possible by the outstanding performance of the Tchaikowsky under Karajan, the instrumental delineation I do not think is quite as good. It isn't as easy to pick violas from violins, for instance, but this is a department in which the Philharmonia's acoustics are remarkably strong.

On the other hand there is a freedom from oppression in the louder passages which more intimate miking sometimes causes. There is a danger, too, that the concert hall technique when applied to recording tends to produce an effect of confusion when the full orchestra is playing, something which possibly only bi-aural listening can completely avoid. It is not so prominent when comparatively simple instrumental combinations are being used; in fact the extra airiness gives a spatial effect hard to obtain by any other method.

WIDE RANGE

Dynamic range is particularly wide, and this is the result more of good surface than of high amplitude cutting.

The surface noise is so well suppressed that the players can diminish almost to inaudibility without difficulty. This is a good thing, because distortion is always a danger with heavy cutting, and progressively decreases as the amplitude of the grooves diminishes.

And it is not only in the cutting and processing that the danger lies—it is perhaps more of a hazard in playback, even with the highest grade pick-ups.

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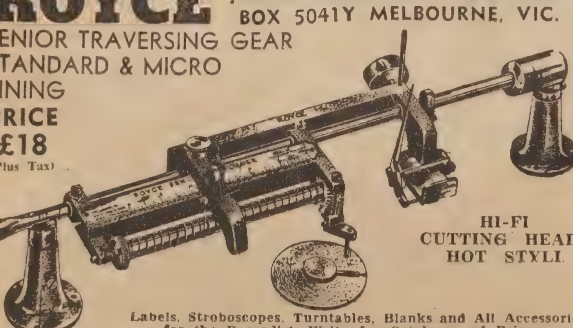
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Frequency range I do not think has been bettered on any previous DGG's. I would say the sound is consistently brighter than with the Philharmonia, and falls short only of the spectacular.

Most important is the way in which all these things have been balanced so that the net result is really satisfying, both sonically and musically.

TCHAIKOWSKY — Symphony No. 4 in F minor Opus 36. Played by the Leningrad Philharmonic Orchestra conducted by Kurt Sanderling. DGG LPM18 DGG LPM18332.

The competitor here, as I have suggested, would be Karajan, and it is possible that the new disc would in my opinion gain a close decision if I had to choose.

This would be because I think the Leningrad players have been most successful in getting the air of wild unrestraint which the music requires.

After hearing first-class orchestras in several parts of the world, I am convinced that national characteristics do play a big part.

We think and move as our temperaments and everyday life condition us, and it is unreasonable to imagine that the music produced by an Englishman, a Dutchman, Italian, and German will be the same.

I don't know how life in Russia will affect a musician because I haven't been there, but you will, I'm sure, hear at once the extra tension and abandon in this disc as compared with most of its competitors.

NO TRICKS

There are no tricks of tempo or dynamics used to gain this effect, in fact the intelligent shaping of climax and crescendo are quite a feature of the performance. It is obtained because the players made it happen and because they intended it that way.

Their flexibility and sensitivity are first class, the brass so freely used here is sharp and full toned, particularly the horns which, as they should, contrast well with trombones and trumpets.

And their strength and vitality handle the severe dynamics of the symphony with complete strength and authority.

By contrast, the Philharmonia, for all its impeccable playing, softens many edges and pulls many punches.

If you are able to compare the opening bars of each, you will have a good example of what I mean.

RACHMANINOFF — Symphony No. 2 in E minor Opus 27. Played by the Leningrad Philharmonic Orchestra conducted by Kurt Sanderling. DGG LPM18327.

In this symphony the Leningrad Orchestra shows how it can handle the completely romantic music which, although it owes so much to Tchaikovsky, is quite different in its feeling and general presence.

Here its sensitivity, which I have already mentioned, is clearly shown to be of the highest order.

No doubt the conductor must share the credit for those exquisitely handled long phrases and beautifully sustained moments which can so easily degenerate into disappointing commonplaces.

Listen to the lovely blend of instruments in the first movement, the delicate steps that are taken through those surging waves of sound, how the violins shimmer against the brass and woodwind.

Noteworthy, too, is some particularly fine clarinet playing in which the tone is quite ravishing. There is, too, an oboe with a quality I have not heard before.

I have often bewailed the failure of many attempts to capture the most elusive quality of Rachmaninoff in other recordings, his genius for stating intimately emotional material, completely irresistible to anyone without a heart of stone.

Rachmaninoff has had many imitators, particularly in film music, and the results have varied from the valliant to the nauseating, but none have faintly approached his peculiar and universal language. This orchestra shows us just how such music should be played. It is a long symphony, but I doubt whether you will begrudge a minute of it.

Of all the records I have received this month, this is the one I came back to most often for the sheer luxury of listening.

I strongly urge you not to miss it.

MOZART — Symphony in G minor KV550; Symphony in E flat KV543. Played by the Concertgebouw Orchestra conducted by Karl Bohm. Philips AOO318L.

With the Jupiter, these were the last of Mozart's symphonies, and probably his best. They have a maturity which clearly looks forward to the work of Beethoven, at least in his earlier periods, and they command the same kind of respect.

The E flat is a bright, vital and altogether happy symphony, a surprising product of a period in which Mozart was far from happy.

MYSTIC QUALITY

The G minor on the other hand has an unusual, almost disturbing mystical quality, particularly in the first movement, through which Schubert said he could hear the angels singing, and which Beethoven himself greatly admired.

Unfortunately it is just this quality which is missing from the performance on this disc. There is a delicately strung intensity behind the music which I looked for in vain. The orchestra seems afraid of it, their approach is much too comfortable.

Nevertheless they play with great distinction, and I thought the E flat was very much nearer the mark.

The recording is not forward, and may be a year or two old. It is a very safe performance with a first rate surface to show it off. To include both symphonies on a single disc is to make a most tempting offer which I'm sure many will not be able to resist, nor is it likely to gather the dust of neglect in any household.

BARTOK—Concerto for Orchestra. Played by the Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG50033.

It isn't possible to talk about this work in a few words, if in fact it is possible to describe it adequately in words at all.

Those, who find Bartok a mystery will shudder at it, those who are unreservedly partial to his music will extravagantly assess it, and those whose position lies somewhere in between will study it to discover why they react to it at all.

Taken separately, the innumerable facets of which it is made are not at all difficult, always absorbingly interesting both melodically and technically, exquisitely imaginative in their employment of orchestration and musical modes, and never discordant except perhaps to the strictly orthodox mind.

CHANGING MOODS

I use the word facet advisedly, because the net impact of the music upon me suggests a many-sided figure rather than a deliberately built structure—one which flashes constantly changing moods and ideas as its shape revolves, one through which light may penetrate and illuminate.

I can imagine no greater contrast with the music of earlier eras, whose logical substance erects a solid and impressive magnificence or even a delicately fashioned work of art, nicely

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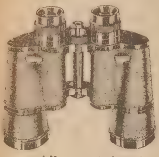

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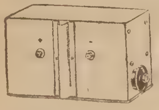

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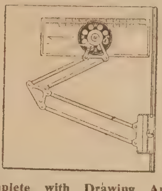

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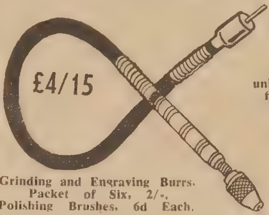

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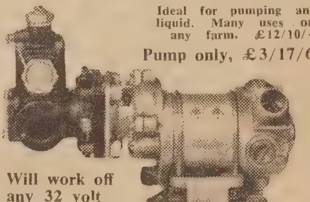

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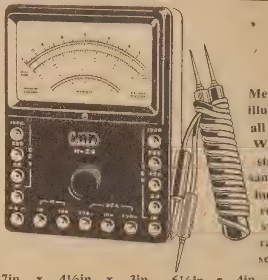

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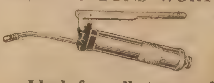

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tooled and tuck-pointed in the way it should go.

Bartok's mind was incisive and orderly in its own way—not that it has necessarily a conventional beginning or end, or abandons convention because it wishes to be capricious.

He has the ability to make use of almost every musical resource because he has need of it, whether it be the exploitation of the subtlest of musical colors and progressions or, as in the last movement, a frugal treatment as unmistakable as is to be found in the earlier classics.

To listen intelligently, therefore, one must really have some appreciation of the musical devices which are being used, and only then is it fully apparent that Bartok has evolved a truly creative spirit which is not paralleled anywhere else, and which I fear has eluded many of his contemporaries.

CONCERTO TREATMENT

This work is called a concerto for orchestra because of its treatment of instrumental groups and single instruments as soloists in a concerto. It leaps from one combination or group to another with the utmost agility which might almost be described as artless if it were not an exhibition of very considerable art.

There is no great sense of progression or cohesion from first movement to the last, no grand closes or signalled finale. You will, I am sure, find it a most rewarding piece of work, which will delight and intrigue you almost endlessly.

I haven't yet been able to think of Bartok as a "great" composer—the significance of that word may die with Sibelius—but he is without doubt an extremely valuable and important one.

Many records by American orchestras, including this combination and its conductor, have frequently strayed into exhibitionism for its own sake, but although I have no other version for comparison, I didn't have this impression here.

Mercury's insistence on clarity and definition are there, but the reproduction is free from mere noisiness and the depredations of the hi-fi bug.

This note of restraint allows them to make the most of the most intricate scoring.

Musically and technically I would rate it very highly,

BEETHOVEN—Sonatas for Violin and Piano No. 1 in D major and No. 2 in A major, Opus 12. Played by Wolfgang Schneiderhan and Wilhelm Kempff. DGG 18083 LPM.

These early sonatas of Beethoven can scarcely be numbered among his best, nor frankly do I feel he was happiest in this musical medium.

There is so much in them which was executed more skilfully in later years. At times they have a sketchy barebones atmosphere and many passages which are very close to mere padding.

However, there are many delightful moments, and very little that Beethoven wrote is really lacking in interest.

Nevertheless Schneiderhan tends to invest them with an air rather more ponderous than they deserve.

The first movement of No. 2 is an example of this. Its extreme simplicity can, I imagine, be handled much more effectively with a brighter touch, although I would not say that he is heavy handed.

Both players seem rather afraid of taking their work too lightly, although if there is a hint of stodginess it is more on Schneiderhan's part than on Kempff's. His tone, too, acquires an edge at times which spoils an otherwise smooth performance.

However, I have a great respect for these performers and their Beethoven, and found much pleasure in their work.

The recording is sound and workmanlike in the DGG manner and should play well on any equipment. Balance is mostly good, the piano being a good deal less forward than the violin and more remote in character.

The RIAA curve is OK although the EMI is probably most suitable.

BEETHOVEN — Ah Perfido, BERLIOZ — Alone and Heavy Hearted, SAINT-SAENS—Beatrice's Aria, "O beaux reves evanouis". Sung by Joan Hammond with the Philharmonia Orchestra conducted by Walter Susskind. HMV OBLP-1073.

One really needs to be a fan of Joan Hammond's to be completely sold on this collection of arias. If you are, you will rate it good value, for all three are the kind of thing which has made her a popular singer here and abroad.

Her voice has never really captivated me, although I have heard more illustrious sopranos who have done no better.

She impresses me as being the product of intensive training, with some good notes and great determination as her main assets, but without much natural tendency to sing either with variety or with charm.

Her variety seems limited to a not uncommon ability to sing loudly or softly in approximately the right places.

And her louder passages would frequently have caused me to shrink less had they been more kindly handled by the microphone.

Ah Perfido is perhaps the most successful. She is altogether too hard a worker for the other two. It is difficult to avoid an impression of monotony which is fatal to them both. She lacks almost completely a sense of style, so that her her attack follows the same general lines irrespective of content.

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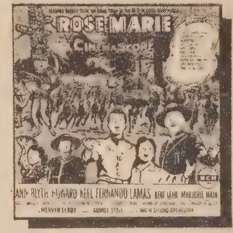
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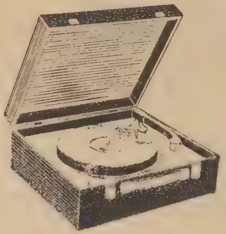

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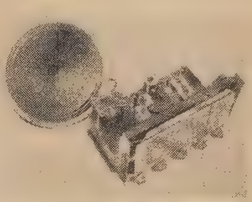

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With these few words I will bow out of the inevitable discussion of a subject upon which many hold firm opinions.

The orchestral background in itself is good, even if its flexibility highlights the singer's lack of it, and often provides a divorcement in musical ideas. The EMI setting I found the best.

GLASGOW ORPHEUS CHOIR—with spoken introduction by the conductor, Sir Hugh Roberton, including Belmont Hymn, Peat-fire Smooring Prayer, Ae Fond Kiss, Bonnie Dundee, Orlington, Eriskay Love Lilt, Ca' the Yowes and the Dashing White Sergeant. HMV ODLP1019.

Simplicity and sincerity are the secrets of the great popularity won by the late Glasgow Orpheus Choir.

I say the "late" choir because it was disbanded in 1951 on the retirement of its conductor, Sir Hugh Roberton, who had been in charge during its entire life of 50 years. Its members felt that they could not continue without him, and, as one member expressed it, "We are allowing the choir to die in order that it might live."

Not long afterwards, Sir Hugh Roberton died, and at his graveside the choir sang the first number on this record—By Cool Siloam's Shady Rill.

The record is almost worth acquiring for this number alone. It is typical of the choir's best style, in which there has been no equivalent before or since.

The bulk of its repertoire was composed of such tunes, supplemented with many folk songs, predominantly Scottish, and arranged by the conductor, whose rich brogue is heard several times introducing those found on this disc.

It is almost certain that most of them have been issued as single items in the past. Although the recording is not brilliant, it is perfectly acceptable and shows no immediate or objectionable evidence of dubbing.

Maybe this is one for the home folks but they are sure to treasure it with affection.

MARCHES MILITAIRES FRANCAISES — played by the band of La Garde Republicaine of Paris. Columbia 330SX 7556.

MARCHING IN HI-FI — Marches by the Central Band of the Royal Australian Air Force. Philips P 10819L.

The music of the Military Band has always held a peculiar appeal for the general public, and can in its own right claim quite a long and distinguished history.

In many ways its sections parallel those of the modern symphony orchestra except that, apart from the percussion, all are wind players.

The Garde Republicaine record is intended to present an historical record of this famous combination from its earliest days, and presented in four sections. These are named Revolution 1789, Napoleon I (in whose triumphal history they played an important part), 1870-1914, and 1914-1945, each representing a period of development.

Selections under these headings illustrate the evolution of the band, its instruments, its style and its music.

As might be expected from a combination whose members are all distinguished performers, there is some magnificent playing to be heard here, given with a polish probably unsurpassed. If you have ever listened much to band music you will have little difficulty in recognising the different atmosphere from that, for instance, of a British Guards Band, or even the RAAF Band soon to be mentioned.

Apart from its own entertainment value, this is one of those records which ought to have been made, and which every bandsman should have, if only to hear how the Marche Lorraine should be played.

The RAAF Band record, on the other hand, is an Australian effort, and a most distinguished one. This band is probably the best known in this country, and is invariably to be found on important occasions, impeccable in its turnout and performance.

On this record it plays a round dozen of the Marches most often heard today, so that it is not really a competitor of the Garde Republicaine.

Both records concentrate on clean, decisive sound. The French players, who

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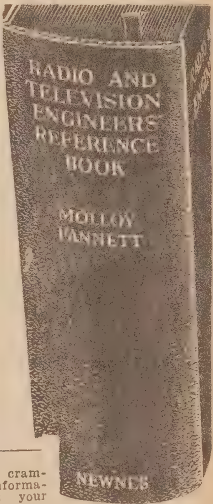

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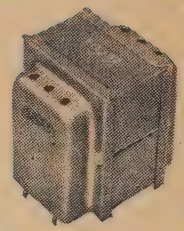

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I would have liked to hear more of the bass tubas in support of all this brilliance, but I would not exchange it at the expense of the clarity found in both discs.

If anything, the RAAF band has the most consistent recording, for some tracks of the French players are not as clean as others.

By the time I had played each record I had certainly had heard a lot of band, and I doubt whether you will ever want to duplicate my performance.

And although I found the Garde Republicaine the most interesting, I feel that Philips are to be the most congratulated on their technical effort.

TCHAIKOWSKY — Suite in G Major (No. 3). Played by L'Orchestre de la Societe des Concerts du Conservatoire de Paris, conducted by Sir Adrian Boult. Decca LXTA 5099.

It is the Fourth Movement of this Suite which is most often played, and which will be familiar to almost everybody.

Not only is it about the same length as the other three put together, but it has an air of entirety quite distinct from the melodious if comparatively diffident nature of these earlier sections.

But the whole Suite is well worth the hearing, even if Side 2 will perhaps be played most often. I have something of a yen for these happier examples of Tchaikowsky, for in them you will find a great many musical exercises which prove that the composer was not merely a producer of tragic and introverted symphonies.

Both performance and recording are lively and bright, without as much weight as we are used to these days, and without always holding the high standard of playing we are inclined to demand. I thought it sounded best with some extra top cut and bass reinforcement, but that is merely a personal reaction. Not perhaps in the top class, but not to be seriously condemned for all that.

This must be one of the few records Adrian Boult has made outside his native land. Although he has now retired from regular conducting, there are many fine discs from his baton still to be released here.

DUKAS—The Sorcerer's Apprentice. FAURE—Pelleas and Melisande Incidental Music. ROUSSEL—The Spider's Feast. Played by the Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG50035.

The most interesting side of this disc is The Spider's Feast, a highly imaginative ballet of great delicacy and charm which I have not heard before.

The scene of the ballet is a garden in which a spider has captured a butterfly which he intends to use as his dinner but is interrupted by a series of events in which other insects are involved.

The story is merely the vehicle for the various episodes of the ballet, five of which are included here.

It's the kind of thing which the Detroit orchestra can handle to great advantage.

The Sorcerer's Apprentice receives a performance quite different from that found in most of its contemporaries.

The mounting tension of the budding magician's desperate attempts to extricate himself from his dreadful predicament is generally portrayed by a crescendo in fairly even tempo.

In this version both tempo and dynamics are varied much more rapidly, a process which, although it highlights the frantic efforts of the panic-stricken youth with great effect, does not give quite as vivid a picture of the rising torrent of water which gradually but remorselessly rises and threatens to engulf the scene.

But this doesn't detract one whit from the standard of performance, which at times is superlatively good.

The extracts from Melisande, the slow movement in this composite French symphony, may not reach the full degree of permissible delicacy, but are beautifully done for all that.

Most record buyers are now familiar with the clean-edged Mercury technique well represented here. I could have wished for a more rounded bass, particularly in the Faure, but could not quarrel either with the instrumental clarity or with the extremely quiet surface which maintains the dramatic improvement achieved by issues under this label.

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SHORT-WAVE NOTES BY ART CUSHEN

FLASHES FROM EVERYWHERE

LUSAKA, headquarters of the Central African Broadcasting Service, has replaced the 3915 Kc transmission with a frequency of 7210 Kc which is used with the old 4826 Kc outlet. A Cyprus listener, reporting this to Radio Australia, states signals are fair but suffer rather severe interference from Moscow on both 7200 and 7210 Kc. Sign off is at 5 am. BBC news was noted at 4 am followed by the Central African news and weather information.

GOLD COAST transmissions in the 31-metre band have been heard by August Balbi in California, using the frequency of 9615 Kc. The Gold Coast Broadcasting Service transmits from Accra, and has been heard from opening at 3.55 pm, with a drum beat as an identification signal. BBC news is relayed at 4 and 5 pm while at 4.35 pm a session of English by radio is broadcast. The station appears to be heard rather irregularly. Checks here find a Moscow transmitter using the frequency from 4 pm, making the reception of Accra rather difficult.

FRENCH SOMALILAND has been reported on the new frequency of 4785 Kc by Stuart Morris, of Victoria. Readers will recall that we reported and verified the station on the old channel of 4970 Kc some months ago. This is the first report of reception since the frequency change. Signals were somewhat spoilt by CW and the station was heard to closing at 5.15 am.

CAIRO, which has not been heard for several weeks due to the bombing of the station in the Suez crisis, has again been heard on shortwave. The station is using the old 9800 Kc frequency and has a program of French at 6 am and English news at 6.30 am. The station is well received, but at times some jamming has been evident on the frequency. The medium-wave station which was on 620 Kc was replaced on this frequency after its bombing by the Cyprus station, which took over the frequency from 635 Kc. Whether this move of placing the station on the old Cairo channel had any influence on the Egyptian listeners, who might mistake the station for the non existent Cairo station, is doubtful.

BRUSSELS is again transmitting in English and has a daily test broadcast to North America on the 11,850 Kc frequency. Reports are requested to Box 26, Brussels, Belgium. The transmission is on the air 10.25-11.00 am. It will be recalled that ORU ceased foreign broadcasts recently, and this was very much regretted by listeners, as its Goodwill broadcasts were rated high in popularity. Listeners were asked to send reports to the station if they wished the broadcasts to continue. The normal transmissions of ORU are still being carried but only in the French and Flemish transmissions

GRENADA is reported by listeners to Radio Australia to have made a further frequency change, and the transmitter is now using the frequency of 17,805 Kc for the sign-on of transmissions at 8 am. The station is operated by the British West Indies Broadcasting Service, and during last winter provided good signals for listeners in this area, considering the power used was only 250 watts.

ADEN'S transmission, which has been reported in this area in the past few years, has a fair signal in California, from opening the transmission at 1.30 am. The station using 7170 Kc. the same frequency as Radio Peking, but signals from the Aden transmission of ZNR can be heard under the Chinese station. ZNR was first verified by the writer in 1940 when this Cable and Wireless transmitter was using 250 watts

HCJB in Quito Ecuador, which has a daily transmission to the South Pacific, has been testing with a 50 Kw transmitter on 9745 Kc. The program Notes session on Saturday features replies to letters from listeners and news on new programs. This last year HCJB has received over 1500 letters from Australia and New Zealand, a big increase from the 300 received from this area in 1953. January saw the introduction of a new English program, Morning in the Mountains, which is broadcast on 11915, 9745 Kc from midnight to 1.00 am daily. The Southern Cross Salute, the normal evening session, is broadcast from 5.00 to 8.00 pm.

DAMASCUS as well as being heard on 17,865 Kc has been logged by Stuart Morris in Victoria at 6.30 am on 15,160 Kc. The singals indicate that this is a high powered transmitter—possibly the 50 Kw job is now used in this transmission.

ACCRA, which we reported as being heard on 9615 at 4 pm, has also been heard with the BBC news relay at 6 am on the same frequency ZOY has some intereference from Tangiers from 6.30 which spoils reception. Taiwan has been heard by North American listeners to sign off at 3.30 pm after the usual session in English directed to the Americas from the Taiwan station on 11,920 Kc.

HIGH-POWERED TRANSMITTERS FOR MANILA

High-powered transmitters and a new site for these acquisitions of the Far East Broadcasting Company are featured this month.

NEW transmitter site and greatly increased power are the future plans of the Far East Broadcasting Company in Manila, according to a letter from an Australian, Norman Blake, Electronics Co-ordinator of the company This information from Mr. Blake included his appreciation for the many letters from listeners in Australia and New Zealand which the station receives. Although it has no special antenna beamed in our direction, the back of several of the systems appears to give satisfaction.

With the increase of the city limits of Manila, it will only be a few years before the present site is surrounded by houses, so that a new site, some 10 miles from the present location, is being negotiated by the company.

This new location will be on the highway going to Baguio, the summer capital of the Philippines.

NEW EQUIPMENT

The equipment comes from San Francisco where it was the original KWID. It consists of one 50 Kw RCA transmitter, with two final tank circuits of 50 Kw, each tuned to different frequencies but employ one modulator. A change frequency is simple: just the press of a button and the alternate final comes in.

Along with this is a General Electric 100 Kw transmitter, and all the associate equipment

Mr. Blake was in California to take over the supervision of dismantling. The job took 47 days, the antenna farm being included in the purchase. As of this moment the company is negotiating for another site for its installation.

NEW FREQUENCY

It is hoped during the coming months to transfer all the equipment at the present site to a new building, and plans are under way for the registration of a frequency in the 21 Mc band. This new 13 metre transmitter will be of 1500 watts, and should be testing in March. The new high power equipment will not be used till 1958, the main trouble being the granting of high power for the present frequencies used.

The new 13 metre outlet will possibly use a rotary beam antenna. The number of receivers in the area which cover this frequency is expected to be small, but good signal strength should be obtained by those who have suitable sets.

Mr. Blake has been with the FEBC for four years, three of these being in the portable receiver department, where pre-tuned receivers are made for listeners in the Philippines. Three American and four Filipino technicians keep the equipment in order, which now covers the following stations: DZAS (680), DZFE (1030) on broadcast band. DZW2 (3345), DZH6 (6030), DZH7 (9730), DZH8 (11,850), DZH9 (15,300) DZ16 (17,805). Mr. Blake concludes that the shortwave pages of Radio, TV and Hobbies are like a breath of fresh air from home

Notes of interest from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times used are Eastern Australian.

Jap service to S. America

AFTER testing the new frequency of 9525 Kc Radio Japan introduced this frequency in late December in the service to South America from 7.00 to 8.00 pm daily. The transmission is of 30 minutes in Spanish, the balance of the program being in Japanese. Signals are strong in this area, with no interference, though Australian listeners may experience side interference from Radio New Zealand using 9540 Kc. The timing of this transmission to South America seems to us a little astray, as the time on the Pacific Coast of South America, to which the service is directed, is only 4 am when programs are sent out.

SARAWAK ON 6060 Kc

The transmitter of the Sarawak station at Kuching, has been noted on 6060 Kc by Australian listeners during the relay of the news from the BBC at 11 pm. The latest schedule from the station indicates that this frequency is used only for the daytime transmission. It thus appears that the whole transmission, for both day and night broadcasts, is now on this 49-metre band frequency, although checks have found the signal not in evidence on this band: The schedule is 2.00-3.15 pm on 6060: 7.00 pm-12.45 am on 5052 Kc.

* * *

High power for Burma

The Burma Broadcasting Service in Rangoon will shortly operate with four 50 Kw transmitters from a new transmitting site located near Rangoon. The station, which is nearing completion, will use one of the transmitters on broadcast band, reports Ken Boord Editor of The World at a Twirl, while the other three transmitters will be used for overseas broadcasts on shortwave. The station plans to transmit programs to New Zealand, Australia, Philippines, Japan, China, Middle East, Europe and the West Coast of North America. Chief Engineer of the BBS O. Wing Morn designed the station It is of the most modern type

* * *

Delhi reverts to 21,650 Kc

All India Radio in Delhi, in the transmission for Australia and New Zealand from 8.00 to 9.00 pm daily, is again using 21,650 Kc The station for some days operated on 21,480 Kc the same channel as is used by Radio Netherlands in Hilversum, much to the detriment of both signals: The change has meant both signals can now be heard free from interference, the Delhi frequency of 21,650 Kc being used up to 8.00 pm by Cologne, Germany The other frequencies in the broadcast from Delhi are 17,705 to this area, and 15,105 and 17,760 Kc carry the program for listeners in North-East Asia

LEOPOLDVILLE has been reported by a listener to Radio Australia as being heard on the new frequency of 4760 Kc to close down at 7 am The station was heard with an uninterrupted program of light orchestral music, and at 6.45 am the announcement was given as "Radio Congo Belge in Leopoldville" The station left the air at 7 am.

NEW YORK signals are strong on the two transmitters of WRUL which operate from the studios in that city. They are at present using 17,750 and 15,200 Kc in the transmission to Europe, from 5.45 am daily. The broadcasts on Saturday include the popular Hit Parade program, which is presented by Jack Parry. The English program ends at 7.00 am when generally a broadcast in Swedish is presented. The programs are of high quality, and reports are appreciated by the staff of WRUL, addressed to the station at 57th St., New York City.

AFRICAN signals are reported in the mornings by Stuart Morris, of Victoria, who has been hearing the Brazzaville station on 11,970 Kc at good strength from 8.00-9.00 am. A new session in English is released at 8.45 am Nearby Leopoldville station Radio Congo Belge has been heard on Sunday mornings on 9210 Kc at 7.00-9.00 am, with the slogan of the Leopoldville station, Radio Congo Belge

SOUTH and CENTRAL AMERICAN signals are usually in evidence on New Year's Day when stations in this area with all-night dance programs are heard at later than usual times. The most interesting signal here at this location was HJLB operating on 6040 Kc from Ibaque, Colombia, which was heard after 5 pm Guatamailian stations were also noted on several frequencies, with one new one, TGXB, Radio Musical Centro Guatamala, on 6220 Kc being heard at fair strength at 6 pm. The programme was of marimba recordings with frequent telephone conversations to listeners who were ringing up with good wishes. Radio Nuevo Mundo on 5990 and TGOA on 6100 Kc were also noted Venezuelian, Colombian and Ecuadorian signals were numerous on the 60-metre band, and the strongest was HJEF on 4765 Kc which broadcasts from Cali Colombia and identifies as RCO "Radio Cadena Occidental".

THE HAM BANDS WITH BILL MOORE

The portion of the radio spectrum around 50 Mc/s should provide excellent opportunity for DX working by amateurs during the next two years. Ionospheric predictions show propagation conditions during the period are likely to be the best yet experienced.

THE F2 layer Maximum Usable Frequency prediction charts issued by the Central Radio Propagation Laboratory, show the MUF higher than in 1946 when US amateurs first worked across the Atlantic.

MUF's as high as 54 Mc are recorded for areas 30 degrees south of the equator.

Unfortunately the cross-Atlantic QSO's will not be repeated on 50 Mc as the band has been lost in Europe to television. The announcement by the RSGB that a new VHF band is now available to UK amateurs was received with much enthusiasm.

The granting of the band was solely the result of protracted negotiations between the society and a co-operative post office.

The 4-metre band, 70.2 to 70.4 Mc, is a welcome addition to VHF allocations and chances of contacts with USA stations cross-band to 50 Mc should be good within the next 12 months when the MUF's are expected to rise to at least 70 Mc on occasions.

At the moment UK and USA amateurs are concentrating on the possibility of 28 to 50 Mc cross-band QSO's.

CROSS-BAND CONTACTS

Cross-band contacts generally are difficult to make as it usually means that schedules have to be arranged to ensure operation at appropriate times and at the VHF's two-beam antennas are generally necessary.

Australian amateurs, too, will operate at a disadvantage as they will be relying on cross-band 56 to 50 Mc for DX to repeat the KH6 contacts of the last sunspot maxima.

North American stations should still have plenty of opportunity to contact South Americans as 50 Mc activity down there is high. They will also be concentrating on work with South Africa.

A suitable path is often available to this continent In South Africa American mobile services have already been heard up to 43 Mc and at times the MUF for contacts with Europe has been estimated to be up to 50 Mc.

The JA's enjoy one of the best locations for 50 Mc working and already the MUF has been at 60 Mc up there. Plenty of opportunity to work them cross band should be available to VK amateurs this and next summer. North to South America contacts on 50 Mc have been made when the MUF was only estimated at 36 Mc.

The peak of the solar cycle should make things very interesting on the higher frequencies and the co-operation of the world's amateurs with the IGY program on 50 Mc observations should provide the stimulus for some real DX shattering records during the next couple of years.

* * *

TV interference in UK

A NEW policy has been introduced in the UK with reference to interference to television reception by amateur stations due to "blocking"

The post office has agreed after lengthy negotiations by the National Amateur Society, the RSGB, that if an amateur is otherwise transmitting within the terms of his licence, but causes interference to sound or television reception on a satisfactory receiving installation and it can be demonstrated that a reasonable remedy, such as the fitting of a simple filter, is available to the owner of the receiver, then the amateur will be allowed to continue operating after an interval of one month from the time at which the cure is explained and demonstrated to the complainant by the post office.

The change of policy was received with acclaim by amateurs as they can no longer be blamed for interference due to faulty receiver design when their transmitter is operating correctly.

The onus would normally be on the complainant to pay for the remedy, but this would not preclude an amicable settlement whereby the amateur provides a filter, as not infrequently happens now.

This new policy will be applied to all cases of interference to sound and television reception where the amateur's transmission is found to be within the terms of his licence and will cover in particular IF and image break-through as well as blocking.

The number of cases where there is no reasonable remedy is likely to be very small and these will be dealt with on their individual merits.

The post office has informed the British manufacturing association, BREMA, that the revised arrangements will be introduced

AMATEURS TO WORK FOR CIVIL DEFENCE

THE report of President Jim Corbin, VK2YC, to the NSW Division on his return from the Civil Defence First Commuications School held at Macedon, Victoria, provided an excellent insight into anticipated amateur radio participation in civil defence working.

The first communications group comprised 28 representatives from the various State Governments, the armed services, Commonwealth Departments and with Jim the sole amateur and WIA delegate

An extensive study program was arranged with lectures extending for seven hours per day and films at night, all aspects of civil defence preparation and nuclear warfare were covered.

Of particular interest to amateurs are the following points that evolved:

A complete picture of the WIA NSW Emergency Net operation was presented during discussions. This included a map showing the coverage of net stations. A map of Sydney with VHF stations pinpointed and prepared by VHF section president Perc Healy, VK2APQ, was also tabled.

Novice licences

THE subject of novice licences for amateurs was also discussed and general support afforded the idea. It was agreed that the WIA be officially recorded as representing the radio amateur of Australia.

Another suggestion that received support was that the country amateur be given the task of reading radiation fall-out and that these observations be forwarded via the WIA Net Emergency Channels to headquarters. Main centres for CD working in NSW will be Newcastle, Sydney and Wollongong.

It was recommended that a Communications Advisory Committee be set up in all States and that at the inaugural meeting a delegate from the WIA be invited to attend.

A number of persons present at the school were either active amateurs (VK2ZI and VK4EF) or ex amateurs and they were able to appreciate, and if needed be, support matters discussed concerning the hobby.

The recommendations made are, of course, subject to review by the Minister and Department concerned. The Minister is Mr Allan Fairhall, VK2KV

JUDGING from general comment not a great deal of money will be made available for CD organisation, and much work will be on a voluntary basis. With this point in view a suggestion was made that disposal equipment should be made available to amateurs for CD work at a reasonable cost.

In the future the outcome of this conference and other matters affecting CD co-operation will be made through the WIA. Undoubtedly, as in similar work in the past, the radio amateur will assist in yet another public activity.

In the future when full-scale civil defence tests are conducted in Australia it is certain that radio amateurs will figure prominently on the communications side of the working.

* * *

Emergency net in USA

AMATEURS in the US played an important role in 1956 during the biggest operation alert yet held. In every State in the US and the provinces in Canada, RACES and other nets provided a valuable adjunct to normal communication circuits theoretically still usable.

The simulated alert provided for the evacuation of thousands of people from contaminated areas.

Casualties were estimated as multi-million from the hundreds of nuclear weapons peppered over the target areas.

Each local net organised their communications to suit the local conditions and authorities' requirements. Frequency bands in use ranged from 1.7 down to 144 Mc depending on the type of circuit required and some nets handled up to 2500 messages during the three-day operation.

Mobile stations were used extensively. The 28 and 56 Mc bands are popular channels for such work over there; whip antennas give excellent performances at these frequencies.

Net control stations were located at strategic points such as Red Cross headquarters, hospitals, or CD centres.

In a review of the alert, civil defence authorities expressed appreciation of the assistance rendered by amateur nets.

Federal convention

THE Federal Convention this year will provide an outlet for the many ideas that arise among individual amateurs.

A proposal fostered by any WIA member is first voted upon by members of his own division. If the majority of voting members are in favor of it the proposal can then be placed by the division as an agenda item for the Federal Convention. This item is then voted upon by all State divisions and when the majority of divisions are in favor the Federal Council vote it as WIA policy.

It can be seen that any proposal to be accepted has first to be agreed upon by a division and finally by the majority of divisions.

If you have any pet idea on the future of the hobby, if it is passed through these logical channels and is accepted you can rest assured it meets with general approval.

* * *

Public relations

AT quite regular intervals these days snippets of news appear in the daily Press or can be heard over B/C station sessions on amateur radio operation. It is pleasing to note that in the past few years the hobby has been receiving excellent publicity in this way, due, it would appear, mainly to the excellent record of radio amateurs during flood emergencies.

Amateurs are much better known to the general public and newspapers are prepared to devote space to any activity out of the ordinary.

The story of Danny Weil, VP2VB/P and the loss of the Yasme was one example.

The visit of Senator Willis, XE2JK and his meeting with Australian amateurs another.

Fortunately most items refer to general topical subjects and not to individual opinions on regulatory matters and the like. These latter topics are far better discussed and handled through the normal WIA channels to ensure that the final opinion presented represents a cross section of amateur thinking.

* * *

WIA broadcasts

OFFICIAL WIA broadcasts disseminating news for radio amateurs are presented each Sunday morning and the following schedule will be interesting to SWL's and amateurs.

Each State division presents its own broadcast and times and frequencies are as follows: VK2WI, Sundays, 1100 EST 7146 Kc; and at 2000 EST on 144 Mc.

VK3WI, Sundays, 1130 EST, 3573 and 7146 Kc, 57.5 and 146.25 Mc simultaneously.

VK4WI, Sundays, 0900 EST, 3560 and 14,342 Kc simultaneously.

VK5WI, Sundays, 1000 SAST, 7146 Kc.

VK6WI, Sundays, 0930 WAST, 7146 Kc.

VK7WI, Sundays, 1000 EST, 7146 and 3672 Kc.

VK9WI, Sundays, 1000 EST, 3.5, 7, 14 and 144 Mc bands simultaneously.

Amateur stations are requested to keep the above frequencies clear during broadcasts and assist the WIA in its service to amateurs.

* * *

VHF activities

THE February meeting of the VHF section of the NSW division will be held at the new meeting place, the Gore Hill Technical College, Clarendon St., Gore Hill. Leo Meyers, VK2KS, will lecture on some aspects of commercial VHF installations. Leo is very well versed in the subject which should provide an interesting topic.

The section conducted a 144 Mc "Merry Xmas" scramble on December 23, with 31 competitors Winner of the event was Dick Norman, VK2ZCF, with VK2ANF and VK2ER tied in second place.

A number of country stations participated to make the event more interesting. They included VK2ZBK of Blayney, VK2AVK, Katoomba, VK2ASA, Wyong; and VK2ZDC, Wyong. One competitor, Bill Rushby, VK2ABR, made a comeback on 144 Mc for the event after an absence of two years.

The group committee will meet early in January to organise their 1957 program.

Latest support is for a voluntary arrangement along the lines of the CW/Telephony Gentlemen's Agreements that work so well in this and other countries. One of the problems encountered is that quite a number of the receivers in use only cover the low end of the band and it is proving difficult to get stations to operate over the full band, a necessary move if the band is to be subdivided for CW and phone working.

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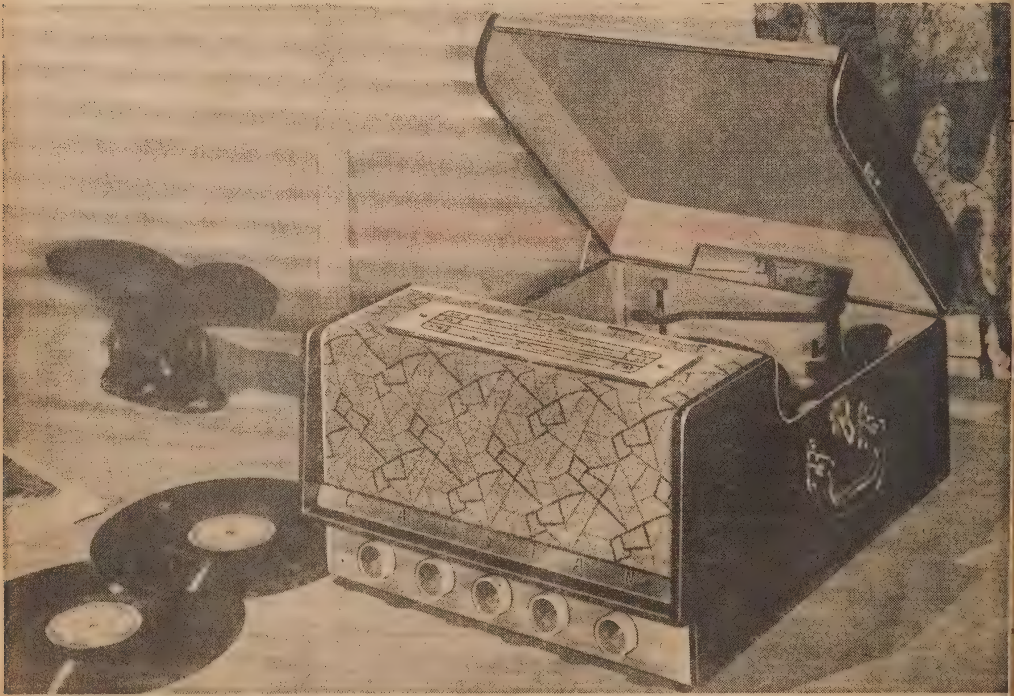

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Activities of YL's

SOME indication can be gleaned of the extent of YL amateur operation in the US by the fact that membership of the Young Ladies' Radio League has risen to 600 since 1936. The league publishes their own magazine, YL Harmonics, bi-monthly and hope to run this year their second international convention

Annually they sponsor a YL-OM contest, and the YLRL Anniversary Party. Of interest too to OM's are a number of certificates issued by the league, the YL worked all States award, YI worked all continents, YL century club.

Another national society is the South African Women's Radio Club. With over 100 members, they issue the ZSYL certificate. Most amateur national society magazines carry their own YL column.

* * *

General notes

AT long last someone has caught up with Chas Mellon, WIFH, who has headed the ARRI DXCC Honor Roll ever since World War II and before it for that matter. Currently with Chas on 267 different countries confirmed is Don Wallace, W6AM. Close behind are W8HGW 265, and W6ENV, 264.

In the telephony sphere Brazilian PY2CK leads with 249 confirmed and second VQ4ERR, 243.

Jock White, ZL2GX, leading representative in these parts, should himself soon appear on the Honor Roll as he now has 254 countries confirmed and the last group on the roll tally 255 countries.

The transistor gang are gradually extending their DX records. The Atlantic has been spanned and WIOGU's signals were heard here in Australia. He only used a doubler to 14 Mc running 78 milliwatts. With this transmitter and a three-element beam on the same band two-way contacts have been established with KP4, T12. OZ7 and G3.

Latest reviews show that approximately 50 pc of the world's amateurs use telephony practically exclusively. Each year more and more amateurs commence on phone and seldom, if ever, revert to CW. Twenty-five years ago saw the then QST Technical Editor, Jim Lamb, introduce Class "B" modulators and 100 pc modulation to amateurs in lieu of the old Class A modulations. Since that date voice has taken over from CW gradually and most of the remaining CW exponents are oldtimers.

Current visitor to Sydney is NSW North Coast Zone officer Noel Hanson, VK2AHH, at present on holidays from the daily grind and contest activity. Noel, like so many other visitors, is busy working mobile on 144 Mc and entertaining the local gang from many points. Using a converted commercial transmitter he will be testing from elevated spots on his trip south to the Snowy.

The loss of the 50 Mc band seems to have affected participation in the Ross Hull Memorial Trophy and activity has been limited to date Some of the Sydney stations close to the TV transmitters also find that all kinds of signals are appearing on the 56 Mc and 144 Mc bands and it is taking a considerable amount of effort to eliminate them.

* * *

Overseas standards

EXAMINATION questions as used in the UK for amateur licences in 1956 give an idea of standards overseas. The following questions were asked at either the City and Guilds of London or Post Office's examinations. In the first examination 518 candidates sat, an increase of 100 over 1955. 458 were successful.

In 1951, 604 sat; 1952, 534; and in 1954, 400; the lowest number recorded. The present rise is encouraging—perhaps better operating conditions are attracting SWL's to the hobby.

Examination questions listed were as follows:

Describe two types of feeders used in a transmitter aerial system. State what steps must be taken to ensure maximum transference of energy to the aerial.

Explain the meaning of the following terms as applied to a radio receiver: (a) Selectivity, (b) Bandwidth, (c) Sensitivity.

Explain with the aid of a circuit diagram and characteristic curves the action of one form of valve detector circuit.

Define the following and briefly state their uses: (a) Auto-bias, (b) Decoupling.

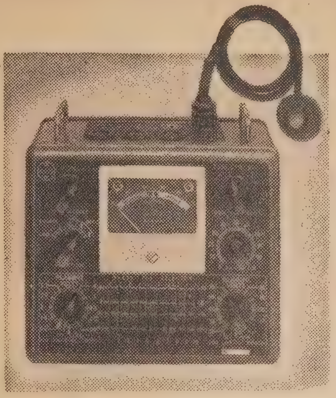
Two capacitors of 4 and 12 picofarads are connected in series; two others of 8 and 24 picofarads are also connected in series. What is the equivalent capacitance if these series combinations are connected in parallel.

If the DC feed to the final stage of a transmitter is 500 volts, 80 milliamperes and the RF current in an artificial aerial load resistor of 750 ohms is 0.2 ampere, calculate:

(a) The power input, (b) The power output, (c) The efficiency of the stage, (d) The anode dissipation.

What do you understand by "second channel interference" and "adjacent channel interference" in superheterodyne receivers and how may they be minimised in practice?

What is meant by "skip distance in relation to propagation of radio waves? Why does "skip distance" vary and what steps may be taken to offset the effect in both transmitter and receiver?



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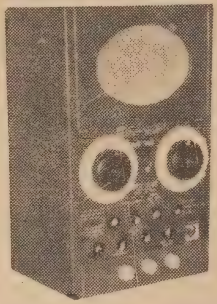

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3D6	10/-	1625	£1/0/0
6AG5	9/6	1629	10/
6AM5	15/	2050	£1/0/0
6AM6	17/6	4307A	10/
6H6	7/6	9001	8/6
6J6	15/	9003	12/6
6J7G	9/6	9004	8/6
6N7	10/	RK75	10/
6SK7	12/6	RK48A ..	£3/0/0
6SL7	12/6	VR75/30	15/
6Y6	17/6	VR105/30 ..	15/
10	15/	VR150/30 ..	15/
12A6	12/6	ATP35	12/6
12H6	7/6	954	7/6
KTW62/6U7 ..	7/6	1T4	12/6
2A3	£1/0/0	1C7	7/6
5U4	12/6	1A5	7/6
1M5	7/6	7193	3/6
1D5	7/6	829B	£4/10/
CV6	3/6	6G8	15/-
6F6	12/6	EL33	12/6
813	£3/0/0	6B8	12/6
VR65A/SP41 ..	2/6	807	£1/-/-
KT66	27/6		

NEW

ELGIN 8-DAY AIRCRAFT CLOCKS

Panel Mounting. 2½ in. Sweep Second Hand. Cost RAAF £28/10/-.
Ideal CAR DASH CLOCK
£7/10/-
POSTAGE 2/-

NEW

12V GENEMOTORS

American, 12V. Input.
270V. 100 MA Output
£4/15/-

PHILIPS SIGNAL GENERATORS

101C
Thoroughly Tested and Calibrated.
Guaranteed Perfect Order.
£29/10/-

New A.R.B. Receivers

8 Valve
4 Band 195 KC To 9.025 Megs.
24V D.C. Operation **£22/10/-**
Converted for 240V A.C. **£33/15/-**

RELAYS

6v. 3 Ple Miniature 15/-
1700 SPDT 7/6
1300 SPDT 7/6
500 x 500 SPDT 7/6
12volt DPDT 5 amp £1/-/-
24 volts DPDT 12/6
8-16 volt DPDT 12/6
11 volt AC £1/-/-
Hi-speed Polarised relay .. £2/10/-
400 ohm 12/6
1300 ohm DPDT 15/-
½in Square Section DURAL TUBING UP TO 12ft lengths 1/- per ft.
Hi-lo Phone Transformers .. 4/6
Spirit Level Bubbles, mounted 4/6
Canadian Signal Lamps 12/6
Hi-voltage Lead-Thru- Insulators, 1/6 each, 15/- doz.
Hydrometers, Battery Testers 5/9
Torches 2-cell Focusing 6/9
Multi-Strand 4 core Cable, Yard, 1/-; 100 yards £2/17/6
Tx. Var. Condensers, 300 pf £1/5/-
100 pf £1/1/-
60 pf with Vernier £1/1/-
30 pf £10/-

RADIO

PHONE LA 3845

36 VICTORIA R'D. MARRICKVILLE, SYDNEY, N.S.W

TRAM AT DOOR. STOP 42

COLLAROY ST., COLLAROY — XW5956

A.W.A. 3.B TRANSMITTERS

12 volt operation
to 9 megs. 10 watts output
Airtested, complete with 1 crystal

£29/10/-

NEW AMERICAN MINIATURE MOTORS

Shuntwound, 5600 RPM with gear box.
10 x 1 & 25 x 1 reduction

4V 7 amp	£3 17 6
2V 1.4 amp	£4 7 6
4. 3 amp Series	£2 10 0

Postage, NSW, 3/-. Interstate 5/-.

INVERTERS

6V. 12V. 24V. 32V. DC to
0 Watt to operate Radio, Fluorescent Lights, Shavers, etc.

£8/17/6

NEW TRANSFORMERS

FERGUSON

VIBRATOR TRANSFORMERS

50 q 150 40MA. 6V.	£1 4 6
00 x 300 100 6V.	£1 17 6
325 x 325 125 12V.	£3 12 6

INVERTER TRANSFORMERS

6V 240V 40 watt	3/7/6
2V 240V 60 watt	£3/7/6
2V 240V 60 watt	£3/7/6

C.R.O. TRANSFORMERS

50 x 350 extended to 1000V
.3V 6.3V 215V 4V **£4/5/-**
OSTAGE N.S.W. 5/-. INTERSTATE 7/6.

DIODE VOLTMETERS

2 ranges to 400V
Tested good order
Meter basic 100 microamp

£3/7/6

OSTAGE N.S.W. 5/-. INTERSTATE 7/6

New Coils and Intermediates tandard or miniature to suit all valves.

oils B/C 455 KC	9/6
oils S/W 455 KC	9/6
nters	11/6
oop aerial coils	9/6
lug tuned H.F. coils suit 144 meg.	4/6

NEW

SELENIUM RECTIFIERS

500 V. Halfwave.

300 MA	£2 0 0
600 MA	£3 0 0
1.2 AMP	£5 0 0

250V In
500V Out **£2/-/-** Doubler 300 MA

NEW CONDENSORS

.1 .25, .04 .02, .01, .005, 003 .004, .0001, 001.
Any 1 size or assorted.

£1/10/- per 100

Postage, N.S.W., 4/-. Interstate, 7/6.

WANTED

Communication Receivers Test equipment, P.A. gear. Large or small surplus stock, Best prices. Call, write or phone any time.

OIL FILLED CONDENSERS

1UF 600V. .... 6/6. 5UF 2.5 .... 6/6
4UF 750V. .. 12/6 5UF 400V. .. 6/6
10MFS 500 7.5UF 330V AC 10/-

SCA 522 RECEIVERS

Complete front end and IFs less valves. A ready made 144 meg. or vehicle band converter.

£2/17/6

Photostat circuits

10/-

MAGNETIC PAPER DISC RECORDERS

Recordon. Electronic Secretary Complete with Mike, Phones, Foot Switch. Air Tested.

£37/10/-

813, 832, 829 SOCKETS

20/- ea. post 1/6

P.M.G. JACKS & PLUGS

4/6 pr. Post 1/-

UNIVERSITY V.C.T. UNITS

Roller value chart tested. All ranges. Perfect order.

£22/10/-

MULTIMETERS

AC-DC
5-50-100-250-1000V.
1-5-25-100-500 MA.
2 RANGE OHMS
TESTED ALL RANGES

£8/17/6

Telephone Equipment

Hand sets	£1/9/6
Mike inserts	3/6
Head & breast sets	17/6
Hand sets with prassel switch	£1/15/-
Hand generators	10/-
Adjustable buzzers	7/6

Miniature telephone units to suit. Hand sets or H & B 10/-

NEW

MONITOR UNITS

240V. 50 A.C. Powered. Addition of H. & V. Amplifier. Converts to first class CRO.

£15/-/-

NEW TELEPHONES

Bakelite P.M.G. Type Pedestal Units. Magneto Powered.

£7/10/-

12v DC 300 watt Chore Horse or American Briggs & Stratton

Powered by 1 h.p. Petrol Engine. Air Tested

Perfect order.

£32/10/-

New American miniature

BLOWER MOTORS

12 or 24 volt permanent magnetic fields.

£1/7/6

Postage: N.SW., 1/-; Interstate, 2/.

12 VOLT GENERATORS

New C.A.V. 80 amp Generators. Ideal for lighting or fast charges.

£10/10/-

10-line TELEPHONE SWITCHBOARDS

May be used as single magneto ringing phone, or up to 10 lines as required. New Condition Tested.

£5/10/-

6-lines (as above) £4/5/-

GENEMOTORS

Input	Output		
24V	250V 100MA		£1 0 0
24V	550V 375MA		2 0 0
24V	250V 60MA		1 5 0
12V	500V 350MA		8 10 0
12V	1200V 200MA		6 10 0
6V	500V 150MA		6 10 0
24V	250V. 100 MA.	New	£2 0 0
12V.	300V. 250 MA		£4 10 0
12V.	235V. 50 MA.		£2 15 0
12V	350V 50 MA.		£2 15 0

A.C.E. RADIO

Amplification Communication Electronics

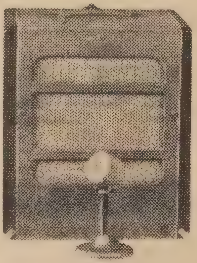
PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W
AND 636 KING STREET, NEWTOWN

EVENINGS and WEEKENDS: "KALUA", COLLAROY ST., COLLAROY — XB5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD, TRAM AT DOOR, STOP No. 42

AMPLIFIERS

FROM £14/17/6



6 valve general purpose 10 watt in plastic covered case Complete with heavy duty Jensen speaker, crystal mike and stand. Input for pickup, mike guitar tuner

£31/15/0

PUBLIC ADDRESS RANGE 340V-AC

6 valve	10 watt	£14/17/6
6 valve	25 watt	£25/ 7/6
6 valve	40 watt	£32/ 7/6

BATTERY ONLY OPERATION

6 valve 6 volt 10 watt	£18/15/-
7 valve 12 volt 10 watt	£19/15/
7 valve 12V. 25 watt	£24/17/6

BATTERY AND A.C. OPERATION

6 valve 10 watt 6V.	£20/15/-
7 valve 12 watt 12V	£21/15/-
7 valve 25 watt 12V	£29/7/6

HI-FI RANGE MULLARD 5/10.

£34/15/0

Complete with Jensen twin cone speaker, Ferguson O.P. transformer, 301 & U.L. taps

MULLARD 5/20 AS ABOVE

£42/15/0

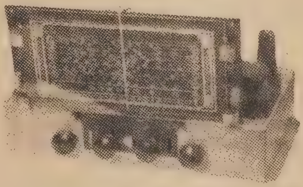
Tuner & separate control box with mike, pre-amplifier. **£12 extra**

10-VALVE HI-FI

RADIOGRAM CHASSIS

Incorporating Mullard 5/10 bass boost amplifier, treble boost dual wave tuned R.F stage Built-in pre-amplifier for microphone or tape recorder including Jensen twin speaker

£42/15/0



Dual wave, 6 valve radiogram chassis Includes bass & treble boost, 12" Jensen or Magnavox speaker

£23/15/0

8 VALVE RADIOGRAM HI-FI CHASSIS

Dual wave, bass & treble boost-tuned R.F stage 12" speaker

£28/17/6

5 VALVE RADIOGRAM CHASSIS

DUAL WAVE, 12" SPEAKER

£18/15/0

5 valve also available as home constructor's Kitset **COMPLETE WITH CIRCUIT.**

£14/15/0

7 VALVE DX RECEIVER

3 band, 2 to 6 and 6 to 18 megs. 160 to 16 meters and broadcast. Exceptional selectivity, sensitivity 2 microvolts. **NEW AUSTRALIANS,** listen to European short wave stations.

£29/17/6

T.V. EQUIPMENT

Formers in cans with special V.H.F tuning slugs and winding data for video and sound I.F.S. and traps	9/6 ea
E.H.T. Transformers for 3000v	£1/15/-ea
5000v insulation Fil Transformers	£2/-/-ea
Video and sound I.F.S. ratio detectors and traps to A.W.A. circuit specifications Pre-aligned.	19/6ea
Wired and tested video and sound I.F strip with traps and ratio detector including valves and circuit. Including valves	£21/-/-
Wired and tested Strip as above, but using new ex-disposal valves and circuit, etc.	£17/-/-

N.B All equipment complies with P.M.G specifications.

Turrets, line transformers, yokes, deflection coils and standard 17" tubes available. Also first class technical and alignment service.

3 SPEED PLAYERS

All makes from

£11/17/6

3-SPEED CHANGERS

£15/17/6

Portable carrying cases, £4/17/6, Players, Changers, £6/15/-

CAR RADIO

A complete range for 6V or 12V as required. Standard fitting:

5 valve	£30/9/0
6 valve	£35/14/0

Tailored to fit late model cars.

5 valve	£35/14/0
6 valve	£43/2/0
8 valve	£52/10/0

All installation fittings, suppressors, aerials etc. are included.

R & H KARSET KIT 1956

Complete with aerial, installation accessories, etc. **£31/15/-**

Wired and Tested £35/15/0

Also available for special frequencies, Small Ships, Bush Fire Brigades, Flying Doctor Service etc., at same price.

A Course in Television

(Continued from page 89)

arrier beat at 5.5 Mc would be fed to he video amplifier grid.

The cathode circuit of this latter tube ontains a circuit which is sharply esonant at the intercarrier beat frequency. At resonance, heavy degeneraion occurs, so that the stage gain at the ntercarrier beat frequency is comparaively low.

The signal for the intercarrier IF mplifier would normally be taken from convenient point in the filter network or at the video amplifier grid, depending on the order of signal required.

Of special interest is the method of ntercarrier feed shown in figure 114. nstead of the intercarrier amplifier being coupled loosely to the detector circuit, the coupling capacitor and input winding are made series-resonant at 5.5 Mc.

This imposes heavy loading on the detector at the intercarrier beat frequency and serves as a trap circuit. At he same time, maximum voltage is available at the first intercarrier IF amplifier grid, due to the resonance.

In fact it is possible to achieve a voltage step-up approaching 2:1 due to he behavior at resonance of the series uned circuit.

This same method is often used where he intercarrier signal is taken from the video amplifier plate circuit, in order o simplify the intercarrier IF amplifier. n such a case, however, it is normal o provide an extra trap circuit tuned to 5.5 Mc, between the video plate and he picture tube input.

As might be imagined, filter, trap and peaking circuits can be varied and combined in a variety of ways, so that there s no hope of covering them completely n an article of this nature. However, by now, the reader should be able to ppreciate the measures which are dopted by different set designers.

In all the foregoing, no reference whatever has been made to a subject which is generally associated with detecors—the subject of DC coupling and estoration. The omission has been uite deliberate and will form the subect of a special article in a following ssue.

(To be continued.)

HERE'S YOUR ANSWER, TOM

(Continued from Page 69)

onnecting a capacitor and resistor in parallel in the grid circuit.

When alternating signals are applied between the grid and cathode, the resulting grid current flowing in the grid ciruit and consequently through the grid leak, causes the voltage drop across the grid leak to charge the capacitor. This harge is effective at the grid of the valve n the form of negative bias.

In the case of conventional amplifying ircuits, a resistor is placed in the athode circuit and use is made of the ombined plate and screen currents to roduce a voltage drop across this resistor.

This voltage drop places the cathode t a positive potential with respect to arth, which is tantamount to applying n equivalent negative potential to the rid.

BUILDING A TUNING UNIT FOR TV

Continued from Page 65

lated. With the aid of this meter, and your ears, squeeze or open the turns on the RF and aerial coils for maximum strength on Channel 9.

If you find that a metal-tipped lining tool touched on the grid or plate increases signal strength, it is an immediate indication that the circuit wants more "C" or more "L". Squeeze the turns together. The reverse is also true.

If poking the tip of a brass screw into the earthy end of the coil increases signal strength, it indicates the need for less "L" or "C". Open the turns slightly.

Having set Channel 9, add the coils or shorting links for Channel 8 and peak them up, if you have a suitable signal source. If you haven't, take them for granted and add Channel 7.

COIL ADJUSTMENT

Set the oscillator coil as already described for Channel 9, then proceed to examine the aerial and RF circuits. Don't touch the Channel 9 coils, which you have already peaked.

Assess by the means already described whether these circuits need more or less L and C. If more, add a slightly longer link between the Channel 8 and 7 switch lugs. If less, make the link short and, if necessary, use a scrap of the braid from shielded wire.

The oscillator coils for Channels 9, 8 and 7 all have the same number of turns. The extra path length through the switch is more than enough to provide the necessary reduction in frequency.

ADDING CHANNEL 2

With these right, Channel 2 can be added. Actual coils are required here, and trimming is achieved by slipping a knife blade between turns and opening up the centre of the coil. Having opened it up, slip a length of 3-16 brass tube temporarily through it and line up the turns again to preserve the appearance.

Channel 1 is added last of all and, even if you cannot peak it up, we suggest you put in the coils as specified, in order to complete the circuit through the shorting link. Channel 1 coils are also peaked by "knifing" with the additional facility that the aerial and RF coils can be lowered in frequency by pushing them closer to the Channel 2 coils.

By careful pruning, it is entirely possible to peak things up so that signals come through at optimum strength on the various Channels without altering the setting of the fine tuning control. But it is there if you need it.

Such, then, is the story of our developmental television tuner. We hope it has given you food for thought.

The Serviceman Who Tells

Continued from Page 41

In vain I tried to convince her that the television station could not possibly affect a broadcast set at such a distance (if, in fact, it would affect one at ANY distance).

WASTED ELOQUENCE

I pointed out that the TV station was undoubtedly well and truly on the air with test patterns, etc., long before the opening ceremony. I also pointed out that the three transmitters had undoubtedly been on all the evening and for several hours prior to the present failure—all without effect on the set.

It was no use. The lady stuck to her guns. With typical feminine logic she considered that any two events which happen simultaneously must be cause and effect.

I countered this with a little mild sarcasm, suggesting that, if she had access to the records, she would probably find that a man died in Chicago at the precise moment that the set failed. Even so, it hardly seemed reasonable to blame the unfortunate demise of the Chicagonian for the failure of the set—or vice versa.

That may have weakened the defences, but it didn't show. Meanwhile, the set was still gurgling along in a most distressing fashion, even though the cry-singer had long since gone down for the third time.

I put down my dry ginger ale, somewhat reluctantly I admit, and pulled the cabinet out from the wall. The chassis was mounted vertically and all the valves were easily accessible. I pulled out the converter, stopping the program but not the crackling. The same thing happened with the IF valve and, somewhat less conclusively, with the audio valve.

Finally I withdrew the output valve (wrapped in a handkerchief) and replaced it quickly. The crackling and distortion vanished and the volume jumped back to normal. I pushed the set back against the wall, salvaged my dry ginger ale (in time to prevent some clot topping it up with lemon squash) and turned to my hostess.

REMOTE CONTROL

In reply to her look of bewilderment I pointed out, in mock seriousness, that I had now put the television station off the air. I'm afraid that was too much even for her defences; in spite of herself she burst out laughing, causing much hilarity all around.

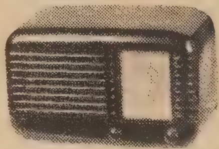
And it was on that note that we ushered in the New Year.

At the time of writing I have not had a chance to track down the real cause of the bother, but I am strongly suspicious of the output transformer, which is probably dithering on the threshold of an open circuit. Anyway that will be another story.

(P.S. I must remember to pay a business visit to the man-next-door. Apparently he has a faulty set, too.)

MAKING UP THE "LITTLE GENERAL"?

—THE IDEAL PRESENT—



£12/17/6

Post and Packing N.S.W., 14/6. Interstate, 25/-.

Complete kit of parts for the 1956 "Little General" as featured August R & H including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F speaker and kit is complete to the last nut and bolt. Set wired and tested £2/15/- extra). Cabinet size 11½in long, 7in high, 6in deep.

Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly 57/6

MIDGET CONDENSERS

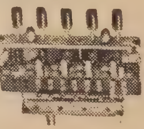
New seven plate midget condenser, ceramic insulation, standard single hole mounting, ¼in spindle, 0-30pf 5/6

NEW SWITCHES

D.P. S.T. Rotary	2/6
Yaxley 3 x 3 SB	3/3
Oak 3 x 2 2B	4/6
Alpha DP DT	3/3
Oak 1 x 2 SB	1/9
Oak 1 x 3 SB	2/-
Oak 4 x 2 SB	3/6

Post extra

NEW PUSH-BUTTON SWITCHES 20/-



Five pole push-button switches .. ..
New control box fitted with above switch also 5 bezels with globes and multi contact key switch.
Post N.S.W. 2/-
Int. 3/-

NEW B.S.R. MOTORS

These English B.S.R. Motors as used on most tape decks, also have many other uses. Size of motor 3in x 2½in x 2¼in with 3/16in shaft, for 240 or 110 volt AC operation.

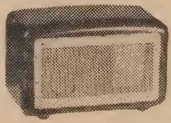
NEW	39/6
Used, but in good condition	27/6

Post: N.S.W., 3/-; Interstate, 4/6

NEW GRAMO-MOTORS

New H.M.V. spring gramo motors, less turntable. Adaptable for many uses. . 19/6.
Postage: N.S.W., 4/6; Interstate, 7/6.

Carbon microphone transformers, new 4/6.
Post extra.



Post and Packing
N.S.W. 10/6; INT. 16/6

NEW ROLA EXTENSION SPEAKERS

Rola 6-9L Oval Speaker, mounted in attractive bakelite cabinet with matching metal grille and complete with volume control.

£3/12/6

METAL RECTIFIERS

90 volt 200mA metal rectifier, suitable for operating relays, etc. 9/6

THROAT MICROPHONES

New American throat mikes, per pair, 3/6

SIGNAL LAMP GLOBES

Lucas signalling lamp globes, 10v 6/- doz

PRE-FOCUS GLOBES

12v 420 watt 7/6

Post extra.

CREED RELAYS

New creed relays supplied with mounting base £3/10/-

OIL FILLED PAPER CONDENSERS

15 mfd. 600v	10/-
8 mfd. tapped at 5 mfd. 110v AC	7/6
1 mfd. 400v	2/9
.01 mfd. 500v	7/6
3MF, 2000v	17/6
1 x 1 400v	2/6

Post extra.

I.R.C. WIRE-WOUND RESISTORS

880 ohms, 50 watt adjustable	5/6
2500 ohms, 5 watt	1/6 or 10/- doz.
4800 ohms, 5 watt 5 p.c.	1/6 ea. or 10/- doz.
200 ohms, 20 watt 10 p.c.	2/3 ea. or 15/- doz.
8000 ohms, 20 watt 5 p.c.	2/6 ea. or 20/- doz.
1000 ohms, 20 watt	2/6 ea. or 20/- doz.
750 ohms, 30 watt 5 p.c.	2/6 ea. or 20/- doz.

BUZZERS

Buzzer, variable note, works off 3 volt battery 7/6
Post 2/6.

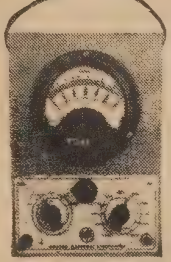
SELSYN-MOTORS

American Selsyn motors 50 volt transmitter or slave £2/-/-
F.O.R.

NEW VIBRATORS

6 volt A.W.A. gas-filled vibrators. Heavy duty synchronous.
NOW 7/6 or 70/- per doz.

NEW UNIVERSAL-MULTIMETER



Manufactured by Robinson Electronics Laboratories, Incorporating 4½in World Famous American Weston Meter and High Stability Resistors.

This high-grade instrument is fitted in a durable and attractive Hammerton-finished case with self-contained batteries and supplied complete with test prods.

D.C. Ranges	A.C. Ranges	D.C. Current Ranges	Resistance Ranges	Output Ranges	PRICE £12/17/6
0-12V	0-12V	0-1.5MA	0-5,000 ohms	0-12V	Plus 12/6
0-60V	0-60V	0-12MA	0-50,000 ohms	0-60V	PACKING &
0-300V	0-300V	0-60MA	0-500,000 ohms	0-300V	POSTAGE
0-1,200V	0-1,200V	0-300MA			

Also Decibel Scale-minus 18 to plus 5db

Please address all correspondence to 479 Parramatta Road, Leichhardt, N.S.W.

METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W. PHONE LM3610

NEW VALVES

IQ5	9/6	6K8G	11/6	6F6	9/6	EZ82	9/6
IT4	13/6	71A	7/6	EL32	9/6	117N7	15/-
IR5	15/-	EK32	15/-	12A6	12/6	4307A	10/-
IS5	15/-	6J8	15/-	6J7	8/6	5Y3GT	12/6
3S4	15/-	6K7	7/6	5U4	12/6	12SR7	3/6
3V4	15/-	KTW62/6U7	7/6	954	5/6	1H6	7/6
IK5	2/6	EF8	9/6	955	5/6	1J6	7/6
IL5	9/6	7C7	3/6	VR65A	2/6	ID8GT	10/-
IC7	9/6	7A6	3/6	EBC33	9/6	1D5	9/6
6U7G	7/6	78	7/6	AV11	5/-	9001	5/-
6G8G	11/6	6AG5	10/6			81	15/-
6SA7	9/6	6B8 Metal	12/6				
6SQ7	9/6	32	5/-				

ALL VALVE PRICES PLUS POSTAGE

RELAY-TYPE COUNTERS

("Mercury" American Made) These relay counters register from 0 to 99,999. Can be supplied with 250ohm coil. 24v D.C. operation.

25/-

Plus Postage.

NEW 5-VALVE D.W. VIBRATOR CHASSIS

These Chassis, by leading manufacturer, are new but shop-soiled. Are supplied in working order and complete with valves, Rola 6in x 9in Oval Speaker. Slide Dial and Vibrator, supply (6v).

List Price over £40.

SPECIAL PRICE,

£15/15/- F.O.R.

Ideal for Boat, Caravan, etc.

NEW AMERICAN INDICATOR-UNITS

Containing 12 Valves.
1. 3 B.P.I. in Separate Shield. 7-6SN7,
1-2x2. 1-6x5. 1-6H6. 1-6G6.

£8/17/6 F.O.R.

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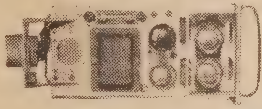

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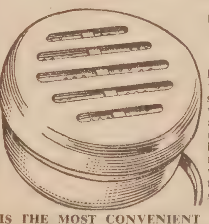

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ANSWERS TO CORRESPONDENTS

J.M.F. (Keswick, SA) writes to say that he s a member of a club, whose members exhange tapes. J.M.F. points out that he reeived a certain number copied from a LP reording and recorder at 3¾ inches per second, vhen played back on his own machine, it ounded faster than the original LP recordng, against which it was compared.

A. The answer to your problem J.M.F. we eel lies in a discrepancy in the speeds of the arious machines used in the process of reording and playback. It is quite possible that he speed of the turntable used to playback the P recording while the tape was being made, vas incorrect. Alternately the speed of the urntable used to playback the LP record when hecking the tape, may have been incorrect. possibility that a similar difference of speeds xists in the tape recorders used, must also e taken into account.

J.G. (Port Kembla, NSW) is interested in uilding a five inch TV receiver, but suggests hat when we describe such a set we comine it with a broadcast receiver.

A. As you have probably already noted J.G., he essential portions of a five inch TV receiver vere described in the December issue. Hower, we would emphasise that the construction f such a set is hardly suitable for a beginner nd it is assumed that only those with a fair ackground in radio theory and practice will ackle it. The suggestion of combining a broadast receiver with it does not appear to offer nany advantages and would be just one more erious complication for the builder. Most readrs will be happy if they make the set work s a TV set, resorting to standard practice for roadcast receivers.

M.C.B. (Winclare, SA) has built the 32 volt reeiver described in Radio and Hobbies some ears ago and is very happy with the performnce. He now wishes to make another such set, sing as many as possible of the 2 volt series f valve which he has on hand .

A. As you can appreciate, the design of such set, even in the rough, would take a lot of ime and we are afraid we cannot offer much elp in forecasting its probable performance. However, there would appear to be no obection to the use of a parallel push-pull outut system, and this idea is often used when dditional power is required without recourse o larger valves. As you say, the use of a 2 olt battery will simplify the filament line, but vill probably make it necessary to use a bias attery.

For the remainder of the set we can only uggest you follow the general design of the riginal, modifying the circuit as common sense ictates to accommodate the alternative valves. fair amount of experiment will probably be ecessary for best results, but should make an nteresting project if you have the time to deote to it.

Many thanks for your kind remarks about e magazine and it is gratifying to learn that retains the interest of the younger readers est assured we do our best to find articles hich will interest them, even though these nay not always appear as frequently as we vould like.

G.H. (Roseville, NSW) intends to use a ickup with the audio section of the "Basic hree" and would like our advice on its conection.

A. The use of a pickup with the audio secion of the "Basic Three" is quite feasible but nly the high output crystal types would be suitble. The pickup is connected across the olume control. Provision will have to be made o break the connection to the previous stage vhile the pickup is in use. A suitable arrangenent would be to provide three terminals on he chassis. One could be the earth connection, he other two being connected to the top of he volume control and the end of the coupling apacitor respectively. For radio use, the oupling capacitor and the top of the volume ontrol terminals could be bridged by a piece f wire.

For pickup use, this bridge should be omitted, nd the pickup connected across the top end f the volume control and earth terminals.

C. Mc. (Hawthorn, Vic.) wishes to build a igh quality amplifier and has narrowed his election to the 17 and 20 watt Playmasters. Hower, as he desires the best possible and lasting esults, he is hesitant at making an investment n the grounds that we may describe a better ersion of these amplifiers.

A. The 17 and 20 watt U-L Playmasters decribed in this journal are comparable in quality. he 20 watt amplifier used EL34 output valves nd was capable of a maximum output of over 0 watts. Both amplifiers have an extreme high rder of performance, and we are no likely to mprove on their results in the near future, or suggest any changes which would outdate any costly components.

J.W. (Kongwack, Vic.) makes reference to the number of transistor receivers published in past issues of this journal and suggests that we feature an article describing a transistor and the manner in which it works.

A. Commencing with the May, 1955, issue, we published a series of articles on the use of transistors. These ranged from a one-transistor set to a four-transistor set. A complete discussion of the general behavior of transistors was featured in the first article and of the specific types used, in the latter articles.

G.H. (Homebush, NSW) wishes to know if it is possible to use a 2A6 valve as the regenerative detector in the "Basic Three" receiver.

A. The 2A6 valve is a duo-diode triode. Tying the diodes to the cathode or leaving them disconnected would enable the triode portion to be used as a detector. To use a triode in the "Basic Three", omit the screen dropping resistor, and its bypass capacitor.

The use of a triode in this circuit will result in a decrease of gain, which may impair the sensitivity to the point where only the local stations will come through with reasonable volume. However, we do suggest that you try this substitution before investing in a new valve.

C.K. (Albany, WA) has recently built up the "Basic Three" receiver, but has had some trouble in the form of a glowing screen in the output valve, which was not noticed until some time later. A .1 meg. resistor was placed in series with the screen, and the output valve functioned normally for several days. After which, according to C.K., the output valve "fizzled out". C.K. believes that we should have mentioned the inclusion of such a resistor in the constructional article.

A. We did not include a screen resistor as suggested because the design of the set does not call for one. The trouble could have been brought about by a faulty component as, for example, a leaky coupling capacitor or an open-circuited grid return resistor. Again, the output transformer could have been faulty, reducing or removing the plate voltage from the valve and leaving the screen to take the total cathode current. However, we feel that the more likely explanation would be excessive HT voltage, due to the use of too low a field coil resistor or failure to follow our circuit in detail. We suggest you read again what we had to say on these points. The HT voltage, when the set is operating, should not be more than about 250 volts, measured from screen to cathode of the output valve.

D.W. (St. Marys, NSW) wishes to fit a magic-eye tuning indicator to a dual-wave radiogram and would appreciate our advice on how to accomplish this.

A. A detailed article on tuning indicators and their application was featured in our May, 1952, issue. But briefly here is the procedure involved. The target anode should be connected to the B-plus line and requires a source of about 250 volts. The anode of the triode section also connects to the B-plus line but via a load resistor usually about 1 meg.

The cathode must be placed at the same potential as the diode load return point, therefore, no initial bias is applied to the indicator grid.

The grid is connected to the AVC line through a decoupling network, typical values being a 1 meg. resistor and a .05 mfd capacitor. With delayed AVC the negative voltage for the automatic volume control is provided by a separate diode. The delay bias for the diode is obtained either by returning its load resistor to a point in the back-bias or to earth if the diode cathode is cathode biased. If a delay in the motion of the indicator shadow is not desired in a delayed AVC system, it will be necessary to connect the indicator grid to the detector diode load.

L.H.L. (Hawthorn, Vic.) is contemplating the construction of the Playmaster No. 9 amplifier, and would like a suggestion as to a Control Unit suitable for use with a good quality magnetic pickup. Also the advisability of using a twin-cone speaker and whether any benefit would be derived by operating this speaker with a tweeter.

A. The choice of a Control Unit is governed to a great extent by the pickup. Since you are considering a good magnetic which usually has a low output, a logical choice is the Control Unit No. 6. This Control Unit was described in the November, 1954 issue and again in the March, 1956 issue. This unit is suitable for use with any good quality moving coil, moving iron or variable reluctance pickup.

There would be little point in adding a separate tweeter to a twin-cone speaker, unless it is a good one and capable of better high frequency results than is the twin-cone job. A cross-over network would be needed at about 5Kc to suppress the high frequency output from the twin-cone speaker. The quality of reproduction obtainable from several speakers properly connected is generally superior to that obtainable from one.

Several good quality "woofer and tweeter" combinations are available on the market. We suggest that you try to hear as many as possible, and settle on the one that satisfies your taste.

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Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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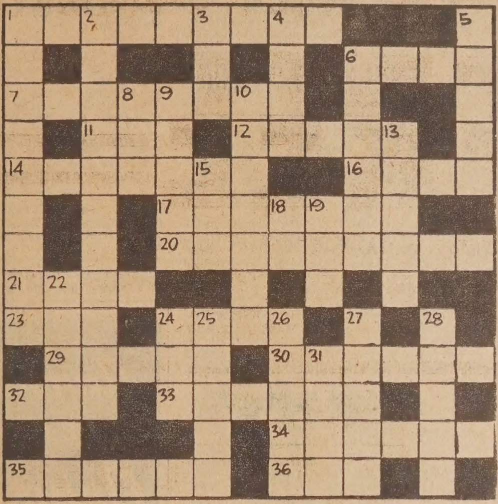


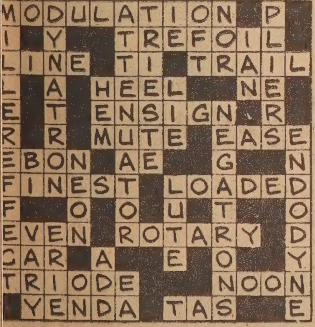
ACROSS

1. Electrically charged particles.
6. Smallest part of an element.
7. Air-cored inductance (2 words).
11. New Zealand bird.
12. Way of expression, natural to a language.
14. Capital of Iran.
16. Greek letter.
17. Part of an electric heater.
20. Demodulators.
21. Severs.
23. Non-flying bird.
24. Self-supporting structure.
29. To prepare a gun for firing.
30. Type of wood.
32. Metal.
33. Anodes.
34. Capacity of a body for doing work.
35. Musical tune.
36. Large quantity.

DOWN

1. Reciprocal of capacity.
2. Circuit path to ground (2 words).
3. Spanish for river.
4. Requirement.
5. Last letter of Greek alphabet.
6. Consecrate with oil.
8. Implement used in billiards.
9. Rented.
10. Energy possessed by a body.
13. Engine supplying motive power.
15. Class of beer.
18. Personal pronoun.
19. French coin.
22. Person who decides game disputes.
24. Unit of current.
25. Electromagnetic switch.
26. Public house.
27. To set again.
28. Metal disc which resounds when struck (pl.).
31. Town in USA.

Solution and further crossword next month



Last month's solution

I.G.L. (Canowindra, NSW) has recenly pur ased a 6-volt car radio, and as the family r has a 12-volt electrical system, he has con ected the set across the first three cells. He as since been advised that this will ruin the ttery, and would like our verification on this lso suggestions for an alternative method of nnection.

A. It is not desirable to connect the 6-volt r radio across half a 12-volt battery, since lf of the battery will tend to be undercharged because of the action of the voltage regulator. If this condiion is allowed to continue it will prejudice the life of the battery.

Other than modifying the radio to operate from 12 volts the only solution is to make up a heavy duty series dropping resistor. Its value would need to be a little over 1 ohm, but would best be determined experimentally. The system would not be ideal since the relatively high source resistance would modify the peak currents flowing in the vibrator circuit. Moreover the power dissipated in the resistor is a complete waste.

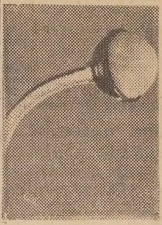
A large electrolytic capacitor, say 500 mfd, rated at about 18 volts working and capable of handling the charge and discharge during the vibrator cycle, may be of assistance if connected across the resistor.

In any case the procedure is to adjust the value of the resistor, so that 6.2 volts appears across the receiver when the battery is at 12.5 volts (motor idle). It will probably be found that the high tension voltage is a little below that when supplied from the 6-volt battery but this cannot be avoided without an elaborate arrangement

H.R. (Roseville, NSW) wishes to improve his Porta-player by the addition of a larger external speaker. However, he has some problems regarding suitable housing for the speaker and mentions several possibilities.

A. Judging by your letter, we feel that your problems regarding speaker housing are ones of convenience, rather than efficiency. Since the Porta-player makes no claims to high fidelity, the improvement in using the larger speaker would be much more obvious than the provision of an elaborate housing for this speaker, assuming adequate baffling.

Under the circumstances, we feel that the simple box baffle would best suit your require-



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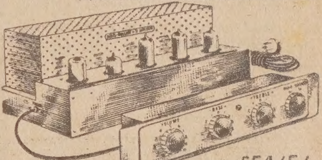

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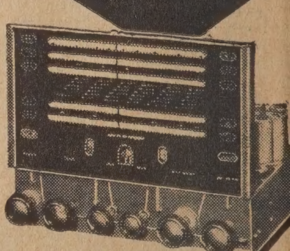

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